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NATIONAL DAM SAFETY PROGRAM. DR. COURTNEY DAM (MO 30017), MISSI--ETC(U)
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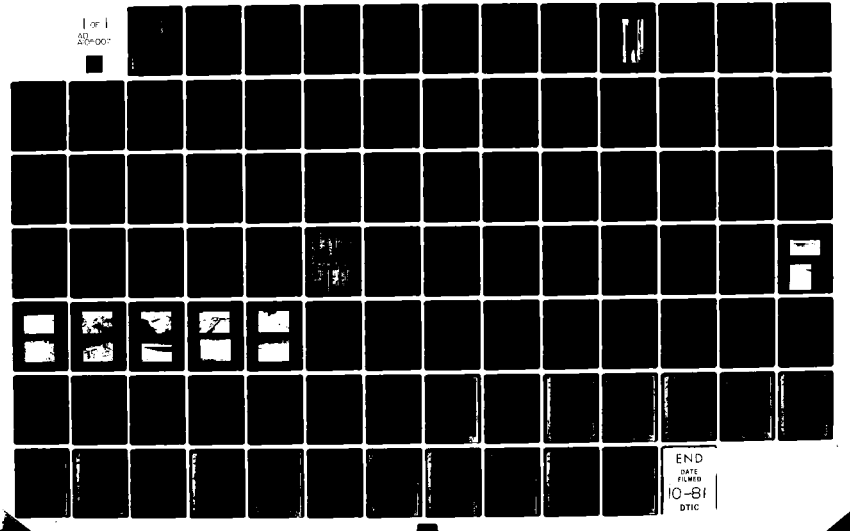

MISSISSIPPI-KASKASKIA-ST. LOUIS BASIN

LEVEL II

DR. COURTNEY DAM
WARREN COUNTY, MISSOURI
MO 30017

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

SEPTEMBER, 1979

UNCLASSIFIED
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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dam Safety, Lake, Dam Inspection, Private Dams

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Dr. Courtney Dam (MO. 30017) Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Dr. Courtney Dam (MO. 30017)

It was prepared under the National Program of Inspection of Non-Federal Dams

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

1) Spillway will not pass 50 percent of the Probable Maximum Flood

2) Overtopping could result in dam failure

3) Dam failure significantly increases the hazard to loss of life downstream

SUBMITTED BY: SIGNED 17 SEP 1979
Chief, Engineering Division Date

APPROVED BY: SIGNED 17 SEP 1979
Colonel, CE, District Engineer Date

DR. COURTNEY DAM
WARREN COUNTY, MISSOURI

MISSOURI INVENTORY NO. 30017

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
CONSOER, TOWNSEND AND ASSOCIATES LTD.
ST. LOUIS, MISSOURI
AND
ENGINEERING CONSULTANTS, INC.
ENGLEWOOD, COLORADO
A JOINT VENTURE

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
FOR
GOVERNOR OF MISSOURI

SEPTEMBER 1979

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Dr. Courtney Dam, Missouri Inv. No. 30017
State Located: Missouri
County Located: Warren
Stream: Unnamed Tributary of the Big Creek
Date of Inspection: May 17, 1979

Assessment of General Condition

Dr. Courtney Dam was inspected by the engineering firms of Consoer, Townsend and Associates Ltd. and Engineering Consultants, Inc. (A Joint Venture) using the "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed by the Chief of Engineers, U.S. Army, Washington, D.C., with the help of Federal and State agencies, professional engineering organizations, and private engineers. The resulting guidelines are considered to represent a consensus of the engineering profession.

Based on the criteria in the guidelines, the dam is in the high hazard potential classification, which means that loss of life and appreciable property loss could occur in the event of failure of the dam. The estimated damage zone extends about one mile downstream of the dam. Within the damage zone are five houses, two county road crossings, one building, one factory, one

warehouse and a railroad crossing which may be subjected to flooding, with possible damage and/or destruction, and possible loss of life. Dr. Courtney Dam is in the small size classification since it is less than 40 feet high and impounds less than 1,000 acre-feet of water.

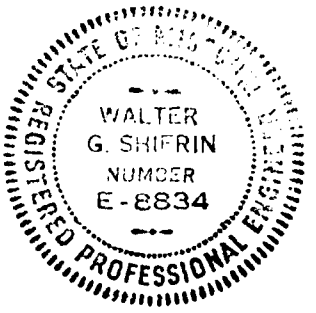
Our inspection and evaluation indicates that the spillway of Dr. Courtney Dam does not meet the criteria set forth in the guidelines for a dam having the above size and hazard potential. Dr. Courtney Dam being a small size dam with a high hazard potential, is required by the guidelines to pass from one-half of the Probable Maximum Flood to the Probable Maximum Flood without overtopping. Since there is high hazard potential downstream of the dam, the appropriate spillway design flood for this dam is the Probable Maximum Flood. Based on available data it was determined that the reservoir/spillway system can accommodate 45 percent of the Probable Maximum Flood without overtopping the dam. Our evaluation indicates that the spillway and the reservoir will accommodate the 100-year flood; that is, a flood having a 1 percent chance of being equalled or exceeded during any given year, without overtopping the dam.

The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorological and hydrologic conditions that are reasonably possible in the region.

Other deficiencies noted by the inspection team were the heavy brush and tree growth and some rodent activity on the downstream embankment slope, lack of a trash rack over the intake of the service spillway pipe, and need for periodic inspection by a qualified engineer. The lack of stability and seepage analysis on record is also a deficiency that should be corrected.

It is recommended that the owner take action to correct or control the deficiencies described above.

Walter G. Shifrin, P.E.



Overview of Dr. Courtney Dam

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DR. COURTNEY DAM I.D. No. 30017

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NATIONAL DAM SAFETY PROGRAM

DR. COURTNEY DAM, Missouri Inv. No. 30017

SECTION 1: PROJECT INFORMATION

1.1 General

a. Authority

The Dam Inspection Act, Public Law 92-367 of August, 1972, authorizes the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspections. Inspection for Dr. Courtney Dam was carried out under Contract DACW 43-79-C-0075 to the Department of the Army, St. Louis District, Corps of Engineers, by the engineering firms of Consoer, Townsend & Associates Ltd., and Engineering Consultants, Inc. (A Joint Venture), of St. Louis, Missouri.

b. Purpose of Inspection

The visual inspection of Dr. Courtney Dam was made on May 17, 1979. The purpose of the inspection was to make a general assessment as to the structural integrity and operational adequacy of the dam embankment and its appurtenant structures.

c. Scope of Report

This report summarizes available pertinent data relating to the project; presents a summary of visual observations made during the field inspection; presents an assessment of hydrologic and hydraulic conditions at the site; presents an assessment as to the structural adequacy of the various project features; and assesses the general condition of the dam with respect to safety.

Subsurface investigations, laboratory testing, and detailed analyses were not within the scope of this study. The conclusions drawn herein, therefore, are based on the presence of, or absence of, obvious signs of distress. No warranty as to the absolute safety of the project features is implied by the conclusions presented in this report.

It should be noted that reference in this report to left or right abutments is as viewed looking downstream. Where left abutment or left side of the dam is used in this report, this also refers to west abutment or side, and right to the east abutment or side.

d. Evaluation Criteria

Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams", Appendix D. These guidelines were developed with the help of several Federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 Description of the Project

a. Description of Dam and Appurtenances

Two drawings for Dr. Courtney Dam were obtained. These drawings are given as plates in the report. The drawings do not appear to be as built drawings, and the dimensions and elevation are, therefore, approximate. The description below is based primarily on field measurements, supplemented by information shown in the drawings.

The dam embankment is a compacted earthfill structure. The owner reported the cufoff trench was excavated to bedrock. Preliminary plans in the Warrenton Soils Conservation Service office indicate a core trench 10 feet wide, 6 feet deep and side slope of 1V to 1H. The crest width is 18 feet, the crest length is 600 feet, and the crest elevation is approximately 852.0 feet above MSL. The hydraulic height of the embankment is 36.0 feet, and the 6 foot high cutoff trench makes the structural height equal to 42.0 feet.

The downstream slope of the embankment was measured as 1V to 3.2H. The upstream slope was also 1V to 3.2H, for the top 4 foot. A horizontal berm 7 feet wide was constructed at elevation 845.0, and the remainder of the downstream embankment slope below elevation 845.0 could not be measured.

No riprap was placed on the upstream slope. The crest and upstream embankment slope is protected by a grass cover, while the downstream slope was heavily vegetated with bushes and trees. According to the owner, the dam was constructed from local materials.

The damsite is situated on the border between the Dissected Till Plain Section of Central Lowlands Physiographic Province which extends to the north and the Ozark Plateau Province to the south. Although the area in which the dam and reservoir are located was glaciated during Pleistocene time, the till and loess which characterize the uplands of the Till Plains have been largely removed by erosion since the end of the Pleistocene. The area is characterized by wooded hills which have gentle to steep slopes.

The bedrock geology of the area, as shown on the Geologic Map of Missouri (1979), typically consists of gently northeastwardly dipping (ca. 30-50 feet/mile) sediments of Paleozoic age. To the north of Warren County these beds are often capped by young (Pleistocene) deposits of glacial drift and wind blown loess. In southern areas of the county the bedrock is generally covered by residual soil, colluvium, or alluvium. The rocks underlying the area are predominately carbonates (limestones and dolomites), although beds of sandstone and shale are not infrequent.

Structurally, as stated earlier, the rocks are dipping gently northeastward off the Ozark uplift to the south of the area of interest.

The bedrock of Warren County contains some minor folding. The largest known geologic structure in the area is a gentle anticline centered about 2 1/2 miles northwesterly of the town of Warrenton. This fold does not appear to affect the beds at the damsite.

Two spillways are located at Dr. Courtney Dam. The service spillway is a 30-inch diameter vertical drop inlet steel pipe located 220 feet from the right abutment. At the bottom of this pipe a 24-inch diameter steel pipe connects to the vertical pipe and is constructed through the embankment to a discharge point at the downstream toe of the dam. A steel anti-vortex plate is located at the intake end of the drop inlet spillway. The downstream end of the service spillway extends 6 feet out of the embankment fill and discharges into a pool located just downstream of the toe of the embankment.

The emergency spillway is an open channel located just beyond the left abutment of the dam. The channel is grass-lined with a bottom width of 36 feet and side slopes of 1V to 3.95H. The maximum depth of the spillway is 3 feet, 8 inches.

A 12-inch diameter corrugated metal pipe was constructed through the embankment as a low level drain pipe. This pipe discharges near the downstream toe of the dam at a point approximately 10-feet to the left and 2-feet above the discharge end of the service spillway pipe. A 12-inch diameter gate valve operated by a handwheel is located approximately 20 feet upstream of the end of the pipe. The gate valve is housed by a 18 inch diameter corrugated metal pipe without cover. The low level drain pipe is located approximately 230 feet from the right abutment of the dam.

b. Location

Dr. Courtney Dam is located on an unnamed intermittant tributary of Big Creek. The creek flows northeasterly for about one quarter of a mile and then easterly for about one quarter of a mile where it joins Big Creek at the

outskirts of the town of Warrenton. Big Creek is intermittant at the confluence with unnamed creek but becomes perennial about three quarters of a mile north at Interstate Highway No. 70. Big Creek continues north-northeastward for about six miles, then swings eastward for about 14 miles where it enters the Cuivre River. The Cuivre, about 13 miles below its confluence with Big Creek, enters the Mississippi about 3 miles east of the town of Old Monroe.

The nearest downstream community is Warrenton, Missouri, located approximately one mile from the dam. The main access from Warrenton, Missouri is west on County Road U one mile to a small gravel road. The dam and lake are located one-quarter mile west of County Road U. The dam and reservoir are shown on the Warrenton Quadrangle Sheet (7.5 minute series) in Section 29, Township 47 North, Range 2 West.

c. Size Classification

According to the "Recommended Guidelines for Safety Inspection of Dams", by the U.S. Department of the Army, Office of the Chief Engineer, the dam is classified in the dam size category as being "Small" since its storage is less than 1,000 acre-feet. The dam is also classified as "Small" in dam height category because its height is less than 40 feet. The overall size classification is, accordingly, "Small" in size.

d. Hazard Classification

The dam has been classified as having "High" hazard potential in the National Inventory of Dams, on the basis that in the event of failure of the dam or its appurtenances, excessive damage could occur to downstream property, together with the possibility of the loss of life. Our findings concur

with the classification. Within one mile downstream from the dam are five houses, two county road crossings, one factory, one warehouse, and a railroad crossing.

e. Ownership

Dr. Courtney Dam is owned by private owners, Dr. and Mrs. Courtney. The mailing address is Dr. and Mrs. Courtney, P. O. Box 336, Warrenton, Missouri, 63383.

f. Purpose of Dam

The purpose of the dam is to impound water for recreational use as a private lake.

g. Design and Construction History

Dr. Courtney Dam was designed by the Soil Conservation Service of Warren County in Warrenton, MO. The S.C.S. plan (included in this report) is dated May 10, 1966. The owner Dr. Courtney, agreed that this date coincides with the time of construction.

The lake and dam were created for recreational purposes only and it receives a limited amount of use.

The lake was reportedly built by Selerick Company of Gumbo, Missouri. This information was also obtained from the Soil Conservation Service.

h. Normal Operational Procedures

As stated above, the dam is used to impound water for recreational purposes only. There are no operational procedures. The lake level is controlled by rainfall, runoff evaporation and the 30 inch diameter steel pipe drop inlet. The lake is also equipped with an 12 inch C.M.P. low level outlet pipe which is rarely used. The gate valve on the downstream side appears to be operable, but could not be reached by the inspection team for trial. There are no operational records kept for this lake and dam.

1.3 Pertinent Data

a. Drainage Area (square miles):	0.43
b. Discharge at Damsite	
Estimated experienced maximum flood (cfs):	24
Estimated ungated spillway capacity at maximum pool elevation (cfs):	1148
c. Elevation (Feet above MSL)	
Top of dam:	852.0
Spillway crest:	
Service Spillway	846.0
Emergency Spillway	848.3
Normal Pool	846.0
Maximum Pool: (PMF)	853.22
d. Reservoir	
Length of maximum pool: (Feet)	1600
e. Storage (Acre-Feet)	
Top of dam:	255
Spillway crest:	
Service Spillway	144
Emergency Spillway	188
Normal Pool:	144
Maximum Pool: (PMF)	291
f. Reservoir Surface (Acres)	
Top of dam:	24
Spillway crest:	
Service Spillway	18
Emergency Spillway	21

Normal Pool:	18
Maximum Pool: (PMF)	25 ±

g. Dam

Type:	Rolled Earthfill
Length:	600 feet
Structural Height:	42.0 feet
Hydraulic Height:	36.0 feet
Top width:	18.0 feet
Side slopes:	
Downstream	1V to 3.2H
Upstream	1V to 3.2H for top 4 feet a 7 foot high berm at El. 848.0, and slope is unknown from El. 848.0 to the toe of the embankment
Zoning:	Unknown
Impervious core:	Unknown
Cutoff:	Unknown
Grout curtain:	Unknown

h. Diversion and Regulating Tunnel — None

i. Spillway

Type:

Service Spillway	Drop inlet
Emergency Spillway	Uncontrolled channel

Length of weir:

Service Spillway	30-inch diameter drop-inlet pipe
Emergency Spillway	36 feet

Crest Elevation (feet above MSL):

Service Spillway	846
Emergency Spillway	848.3

j. Regulating Outlets

Type: 12-Inch Diameter Corrugated Metal Pipe

Length: 200 Feet

Closure: 12-Inch Diameter Gate Valve

Maximum Capacity: 6.5 C.F.S.

SECTION 2 : ENGINEERING DATA

2.1 Design

Dr. Courtney Dam was designed by the Department of Agriculture, Soil Conservation service of Warren County, Missouri. The design drawings are dated May 10, 1966 and are included in this report.

2.2 Construction

Information obtained from the SCS office in Warrenton indicates that the dam was built by Selerick Company of Gumbo, Missouri. Efforts to contact the builder were futile. The field inspection revealed several items not constructed in accordance with the design drawings.

2.3 Operation

There are no written records concerning operation for this dam. Information regarding operation has been obtained verbally from the owner.

2.4 Evaluation

a. Availability

Two design drawings were located which show various features of the embankment and appurtenant structures. No design computations, construction data, or operation data are available.

In addition, no pertinent data was available for review of hydrology, spillway capacity, flood routing through the reservoir, outlet capacity, slope stabiity, seepage analysis, or foundation conditions.

b. Adequacy

The available engineering data is inadequate to aid in evaluating the hydraulic and hydrologic capabilities and stability of the dam for Phase I investigations.

The lack of engineering data did not allow for a definitive review and evaluation. Therefore, the adequacy of this dam could not be assessed from the standpoint of reviewing and evaluating design, operation and construction data, but is based primarily on visual inspection, past performance history, and sound engineering judgment.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were also not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity

The design drawings found are of questionable validity since they are not as-built drawings.

SECTION 3: VISUAL INSPECTION

3.1 Findings

a. General

A visual inspection of the Dr. Courtney Dam was made on May 17, 1979. The following persons were present during the inspection:

Name	Affiliation	Disciplines
Dr. M.A. Samad	Engineering Consultants, Inc.	Project Engineer, Hydraulics and Hydrology
Jon Diebel	Engineering Consultants, Inc.	Structural and Mechanical
Peter Strauss	Engineering Consultants, Inc.	Soils
Peter Howard	Engineering Consultants, Inc.	Geology
Kevin Blume	Consoer, Townsend & Assoc., Ltd.	Civil and Structural

Specific observations are discussed below.

b. Dam

The exposed portion of the upstream embankment slope and the crest has a heavy grass cover which adequately protects the dam material. The upstream slope has no riprap protection and has consequently undergone minor erosion from wave action. However, there was no indication of any instability along the portions of the upstream face that was above water.

The downstream slope of the embankment is heavily vegetated, mainly on its lower portions. This vegetation is mainly trees and brush. It does not appear that the downstream embankment slope has been cleared since the dam was constructed. Extensive rodent activity was observed on the downstream embankment slope.

No signs of past or present instability were seen on the embankment or in the foundation at any location.

No seepage was observed below the downstream toe of the embankment. A small drainage ditch trenching about east-west below the downstream toe of the left side of the dam contains some standing water. This is believed to be from slope drainage on either side of the ditch.

No rocks crop out in the vicinity of the Dr. Courtney Dam. Based on several well logs, and the state geologic map, the rocks underlying the dam and reservoir are most likely the predominately carbonate rocks of the Burlington Limestones (Mississippian). These rocks are dipping gently northeastward about 40 feet/mile.

Overlying the Burlington limestones is a varying thickness of glacial till which to a great extent has been removed to the south of the damsite. (Soil Conservation Service, Soil Survey of Montgomery and Warren Counties, 1979). The soil survey mentioned above, reports that the bottom land soils at the site consist of silty clay (CL-ML, CL) and the upslope soils consist of silty clay (CL-ML), clay (CL, CH) and sandy clay (SC). The local surficial soils are probably mixed loess and residual soils. If the material in the dam is on the silty side (ML), it would probably be more susceptible to erosion and failure during overtopping than if it is the CL or CH of the residual soils.

The owner states that the core trench under the axis of dam is in bedrock. The Burlington Limestone should make an excellent foundation for a dam.

c. Appurtenant Structures

(1) Spillway

The service spillway was not provided with a trashrack at the upstream end of the vertical drop inlet pipe. The anti-vortex plate appeared to be in satisfactory condition. The downstream end of the pipe was extended beyond the embankment materials, and erosion of the embankment is not occurring to any significant extent. The pond formed by spillway discharges is sufficiently downstream of the embankment to avoid saturation of fill or foundation materials.

The emergency spillway contains an adequate grass cover to prevent significant erosion during discharges. Discharges through the spillway will flow away from the embankment, and will not erode embankment materials.

(2) Outlet Works

The low level drain pipe appears to be in satisfactory condition. The 12-inch diameter gate valve is located in an 18-inch diameter corrugated metal pipe pit for protection. The gate valve appeared to be operable. The downstream end of the corrugated metal pipe has steel deflectors welded to the pipe to dissipate energy during releases. The downstream end of the pipe is blocked 1/3 with local materials (See Photo D5 in Appendix A).

d. Reservoir Area

The water surface elevation was 845.75 feet above MSL at the time of inspection. The reservoir rim is gently sloping with trees and woods near the shore. No evidence of any instability was observed.

e. Downstream Channel

The downstream channel is well defined. Some vegetative growth is present in the channel. The channel banks were eroded in the vicinity of the discharge point of the emergency spillway. No major obstructions or debris were found in the channel.

3.2 Evaluation

The following items were observed which could affect the safety of the dam, or which will require maintenance within a reasonable period of time.

a. The heavy vegetative growth on the downstream embankment slope, which includes trees and brush.

b. Extensive rodent activity on the downstream embankment slope.

c. Need for a trashrack at the intake end of the vertical drop inlet pipe for the service spillway.

d. Wave erosion on the unprotected upstream slope of the embankment.

SECTION 4: OPERATIONAL PROCEDURES

4.1 Procedures

There are no specific operational procedures for Dr. Courtney Dam. As mentioned previously, the lake level is controlled by rainfall, runoff, evaporation and the service spillway. According to the owner, Dr. Courtney, the water level has never reached the emergency spillway.

4.2 Maintenance of Dam

Dr. Courtney Dam is maintained by Mr. Schatler, the current caretaker. It appears that the dam crest and upstream slope are maintained very well. There is a heavy vegetative growth of brush and trees on the downstream slope. This cover of brush hinders access to the handwheel operator and gate valve for the low level outlet. The upstream slope at the water level shows slight signs of erosion from wave action.

4.3 Maintenance of Operating Facilities

The service spillway, a 30 inch diameter steel drop inlet pipe, seems to be operating adequately. A new trashrack is required at the inlet of this pipe. The existing trashrack is composed of 2 x 4s which form a box like structure around the inlet and anti-vortex plate. There is a low level outlet composed of an 12 inch diameter C.M.P. with a handwheel operated gate valve on the downstream side. The valve is at the bottom of a 5 foot vertical 18 inch diameter C.M.P. and a key or long rod is needed to operate the valve. It would appear that the valve has not been operated in several years.

The discharge end of the 12 inch diameter C.M.P. was half buried and appeared as if it had not been operated for several years.

4.4 Description of Any Warning System in Effect

The inspection team is not aware of any warning system in use at Dr. Courtney Dam.

4.5 Evaluation

It would appear that the maintenance and care of the dam is adequate with the exception of the growth on the downstream embankment slope. It also appears that the service spillway is in satisfactory condition and operating properly. There is a need, however, for a new trashrack structure around the inlet for the service spillway.

SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. Design

The watershed area of Dr. Courtney Dam upstream from the dam axis consists of approximately 278 acres. Most of the watershed area is wooded and covered with grass. Land gradients in the higher regions of the watershed average roughly 5 percent, and in the lower areas surrounding the reservoir average about 3 percent. The Dr. Courtney Lake Reservior is located on an unnamed tributary of Big Creek. The reservoir is about half a mile upstream from the confluence of the unnamed tributary and Big Creek. At its longest arm the watershed is approximately 0.8 mile long. A drainage map showing the watershed area is presented as Plate 1 in Appendix B.

Evaluation of the hydraulic and hydrologic features of Dr. Courtney Dam was based on criteria set forth in the Corps of Engineers' "Recommended Guidelines for Safety Inspection of Dams", and additional guidance provided by the St. Louis District of the Corps of Engineers. The Probable Maximum Flood (PMF) was calculated from the Probable Maximum Precipitation (PMP) using the methods outlined in the U.S. Weather Bureau Publication, Hydrometeorological Report No. 33. The probable maximum storm duration was set at 24 hours, and storm rainfall distribution was based on criteria given in EM 1110-2-1411 (Standard Project Storm). The SCS method was used for deriving the unit hydrograph, utilizing the Corps of

Engineers' computer program HEC-1, (Dam Safety Version). The unit hydrograph parameters are presented in Appendix B. The SCS method was also used for determining loss rate. The hydrologic soil group of the watershed was determined by use of published soil maps. The hydrologic soil group of the watershed and the SCS curve number are presented in Appendix B. The curve number, the unit hydrograph parameters, the PMP index rainfall and the percentages for various durations were directly input to the HEC-1 (Dam Safety Version) computer program to obtain the PMF hydrograph. The computed peak discharge of the PMF and one-half of the PMF are 4,941 cfs and 2,471 cfs respectively.

Both the PMF and one-half of the PMF inflow hydrographs were routed through the reservoir by the Modified Puls Method also utilizing the HEC-1 (Dam Safety Version) computer program. The reservoir was assumed at the spillway crest level at the start of routing computation. The peak outflow discharges for the PMF and one-half of the PMF are 3,967 and 1,404 cfs respectively. Both the PMF and one-half of the PMF, when routed through the reservoir results in overtopping of the dam.

The stage-outflow relation for the spillway was prepared from field notes, and sketches, prepared during the field inspection. The reservoir stage-capacity data were based on the U.S.G.S. Warrenton Quandrangle topographic map (7.5 minute series). In the routing computations, the discharge through the outlet facilities was excluded due to its insignificant magnitude as compared to the spillway discharge and the PMF. The spillway and overtop rating curve and the reservoir capacity curve are presented in Plates 2 & 3 respectively in Appendix B.

From the standpoint of dam safety, the hydrologic design of a dam aims at avoiding overtopping. Overtopping is especially dangerous for an earth dam because the downrush of waters over the crest can erode the dam embankment and release all the stored water suddenly into the downstream floodplain. The safe hydrologic design of a dam requires a spillway discharge capability, in combination with an embankment crest height that can handle a very large and exceedingly rare flood without overtopping.

The Corps of Engineer designs its dams to safely pass the Probable Maximum Flood that is estimated could be generated from the upstream watershed. This is the generally accepted criterion for major dams throughout the world, and is the standard for dam safety where overtopping would pose any threat to human life. According to the Corps criteria, the hydrologic requirement for safety for this dam is the capability to pass from one-half of the Probable Maximum Flood to the Probable Maximum Flood without overtopping.

b. Experience Data

No records of reservoir stage or spillway discharge are maintained for this site. However, according to the representative of the owner, the maximum reservoir level was about 6 inches above the crest of the service spillway.

c. Visual Observations

Observations made of the spillway during the visual inspection are discussed in Section 3.1c(1) and evaluated in Section 3.2.

d. Overtopping Potential

As indicated in Section 5.1-a, both the Probable Maximum Flood and one-half of the Probable Maximum Flood, when routed through the reservoir, resulted in overtopping of the dam. The peak outflow discharges for the PMF and one-half of the PMF are 3,967 and 1,404 cfs respectively. The PMF overtopped the dam crest by 1.22 feet and one-half of the PMF overtopped the dam crest by 0.17 feet. The total duration of embankment overflow is 1.00 hour during the PMF, and 0.33 hour during one-half of the PMF. The spillway for Dr. Courtney Dam is capable of passing a flood equal to approximately 45 percent of the PMF just before overtopping the dam.

The computed one percent chance flood using 100-year, 24 hour rainfall data was routed through the reservoir, and is given in the last section in Appendix B. The routing results indicate the spillway and the reservoir will accomodate the 100-year flood without overtopping the dam.

The failure of the dam could cause extensive damage to the property downstream of the dam and possible loss of life. There are five dwellings, two county road crossings, one building, one factory, one ranchouse and a railroad crossing within about a mile downstream from the dam.

The local surficial soils at the dam site are probably mixed loess and residual soils. If the material in the dam is on the silty side (ML), it would probably be more susceptible to erosion and failure during overtopping than if it is the CL or CH of the residual soils.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

There were no signs of settlement or distress observed on the embankment or foundation. Some minor wave erosion was observed on the upstream slope of the embankment. This condition has not progressed to a serious degree at this time, but should be monitored and repairs made as required.

The heavy vegetative growth on the downstream embankment slope should be cleared as soon as possible. This growth prevents proper inspection of the embankment in addition to providing a hazard to the embankment. The rodent activity should also be eliminated from the downstream embankment slope.

The service and emergency spillways appear to be in adequate structural condition. Discharges through each spillway will flow away from the embankment to avoid erosion of embankment materials. The service spillway pipe appears to be constructed satisfactorily. Anti-seep collars are shown on the available drawings of Dr. Courtney Dam.

No problems were observed with the outlet works which will jeopardize the structural stability of the dam.

b. Design and Construction Data

The incomplete design drawings are the only data relating to the structural stability of the dam or appurtenant structures that were found. No seepage and stability analyses were available for review.

c. Operating Records

No operating records are available relating to the stability of the dam or appurtenant structures. Water levels have not been recorded, however, the reservoir was full on the day of inspection, and is assumed to be close to full at all time.

d. Post Construction Changes

No post construction changes exist which will effect the structural stability of the dam.

e. Seismic Stability

According to the Seismic Zone Map of Contiguous States, Form TM 5-809-10/NAVFAC P-355/AFM 88-3 Chapter 13; April 1979 the portion of Missouri in which Dr. Courtney Dam is located in Seismic Zone 2. This means there is only moderate damage probability. A detailed seismic analysis is not felt to be necessary for this embankment under present conditions. If a stability analysis is to be performed, the seismic coefficient recommended is 0.05.

SECTION 7: ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

It should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team.

It is also important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there by any chance that an unsafe condition could be detected.

a. Safety

The spillway capacity of Dr. Courtney Dam was found to be "Seriously Inadequate". The spillway/reservoir system was found to accomodate only 45 percent of the PMF without overtopping the dam.

The major problem with the embankment is the heavy brush and tree growth on the downstream embankment slope. The extensive tree growth is considered unsatisfactory in terms of dam safety for several reasons: First, trees toppled by wind expose holes that invite rapid erosion, and second, decay of large existing root systems could form channels for eventual piping. The trees on the downstream embankment slope should be removed. Removal of large trees should be under the guidance of an engineer experienced in the design and construction of earthen dams. Indiscriminate clearing could jeopardize the safety of the dam. Rodent activity should be eliminated from the embankment.

The sloughing and erosion due to wave action on the upstream embankment slope is not a problem at this time. The conditions, however, should be monitored and repairs made as required.

No seepage and stability analyses were available for review. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" should be performed and made a matter of record.

A trashrack should be provided at the intake of the service spillway pipe. The pipe is susceptible to plugging in its present condition during continued flows through the spillway.

b. Adequacy of Information

Satisfactory information concerning the dam and appurtenant structures is not available. It is recommended that the following programs be initiated to help alleviate this problem:

1. Periodic inspection of the dam by an engineer experienced in the design and construction of earthen dams should be made and this inspection report made a matter of record.

2. Set up a maintenance schedule and log all visits to the dam for operation, repairs and maintenance.

3. Perform seepage and stability analyses comparable to the "Recommended Guidelines for safety Inspection of Dams".

c. Urgency

A program should be developed as soon as possible to monitor at regular intervals the deficiencies described in this report. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. The item recommended in paragraph 7.2a. should be pursued on a high priority basis.

d. Necessity for Phase II Inspection

Based on results of the Phase I inspection, and if the remedial measures recommended in Paragraph 7.2 are undertaken as soon as possible, a Phase II inspection is not felt to be necessary.

7.2 Remedial Measures

a. Alternatives

Spillway capacity and/or height of dam should be increased to pass the PMF without overtopping the dam.

b. O & M Procedures

1. Clear the trees and brush from the downstream embankment slope.

2. Eliminate rodent activity from the downstream embankment slope.

3. Place a trashrack over the intake of the service spillway pipe.

4. Monitor the sloughing and erosion on the upstream embankment slope, and make repairs as required.

5. Remove the blockage of the outlet pipe at the downstream end due to local debris.

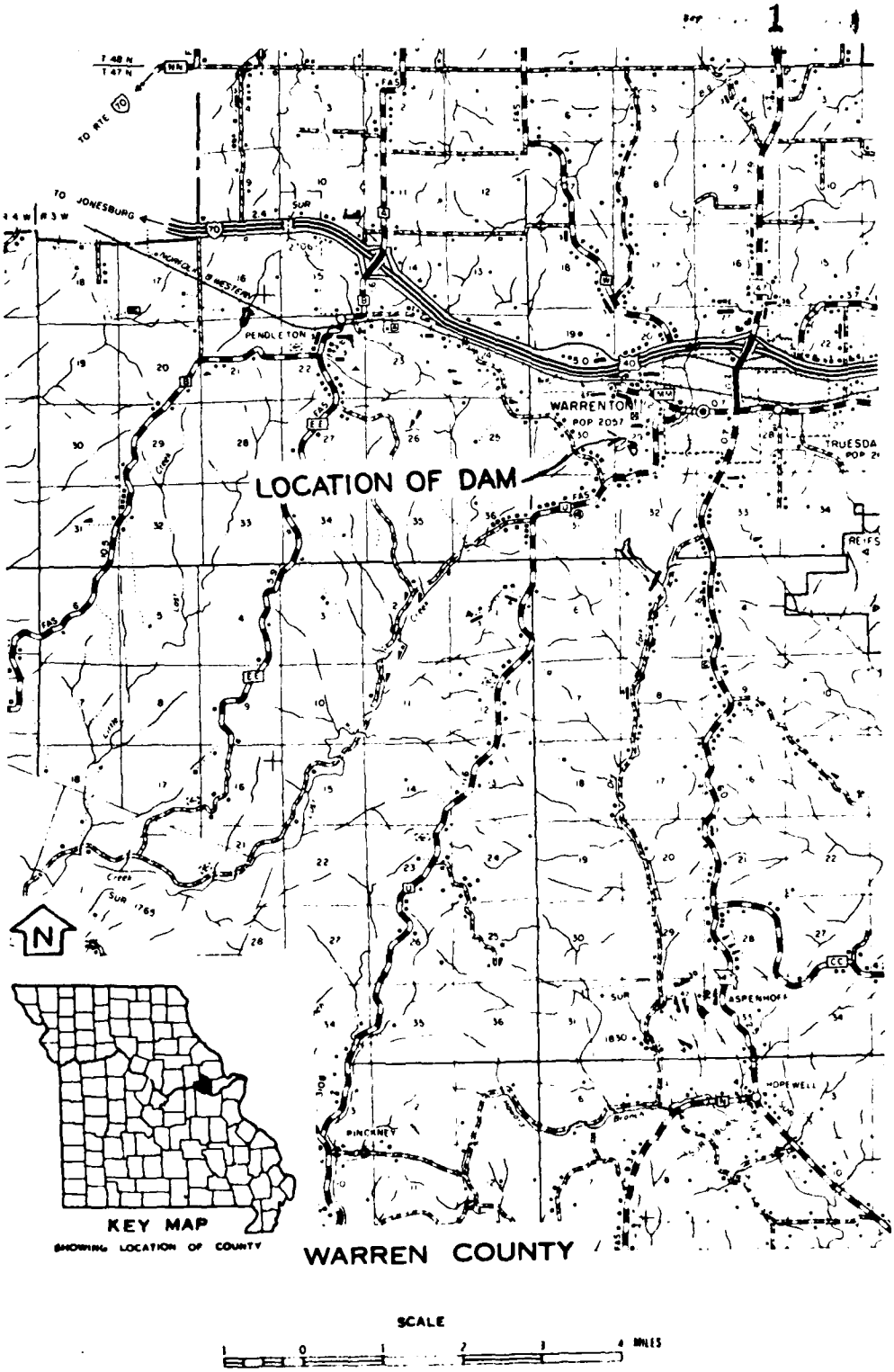
6. Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of dams.

7. The owner should initiate the following programs.

   (a) Periodic inspection of the dam by a professional engineer experienced in the design and construction of earthen dams.

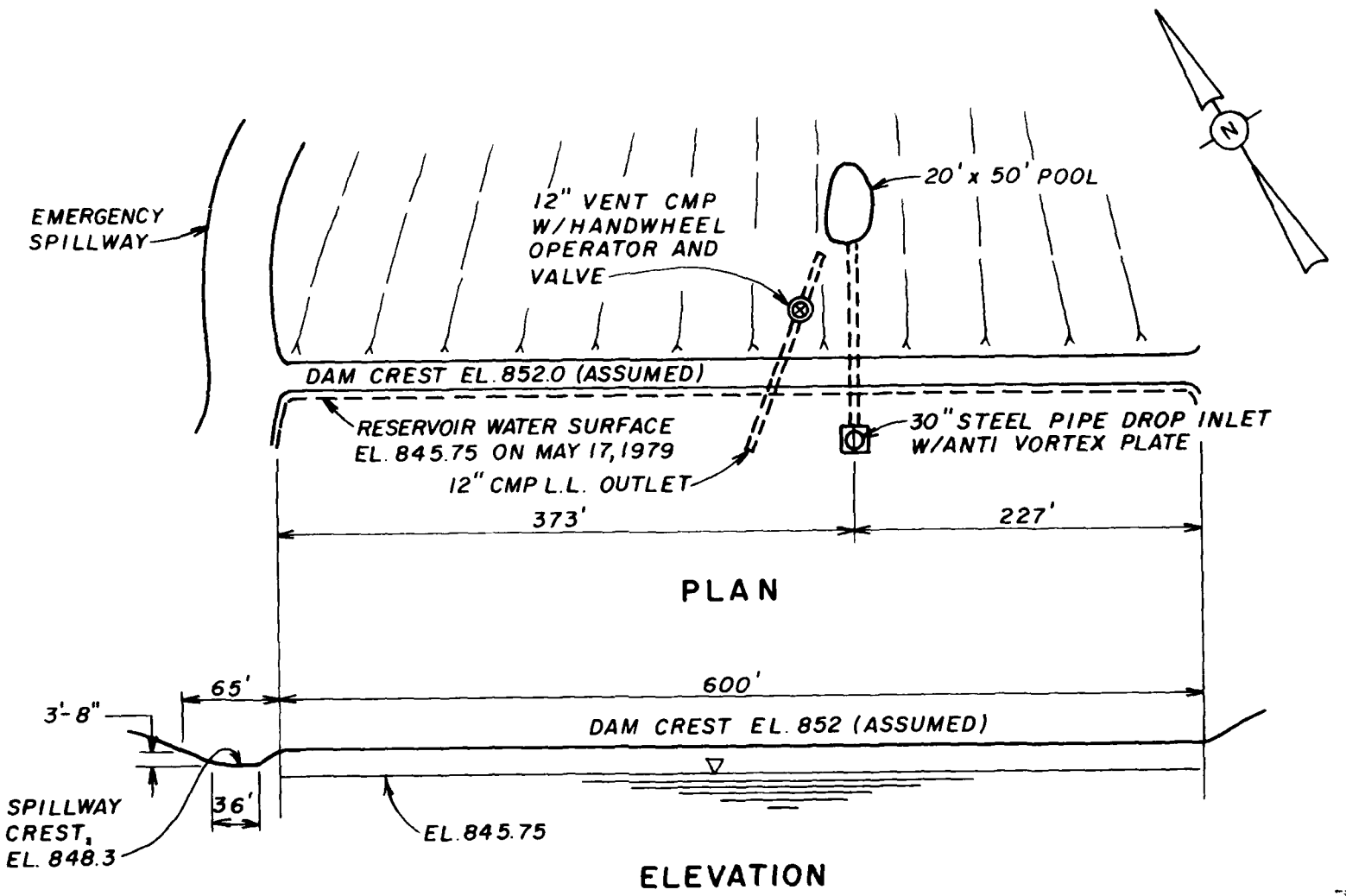
   (b) Set up a maintenance schedule and log all visits to the dam for operation, repairs and maintenance.

PLATES

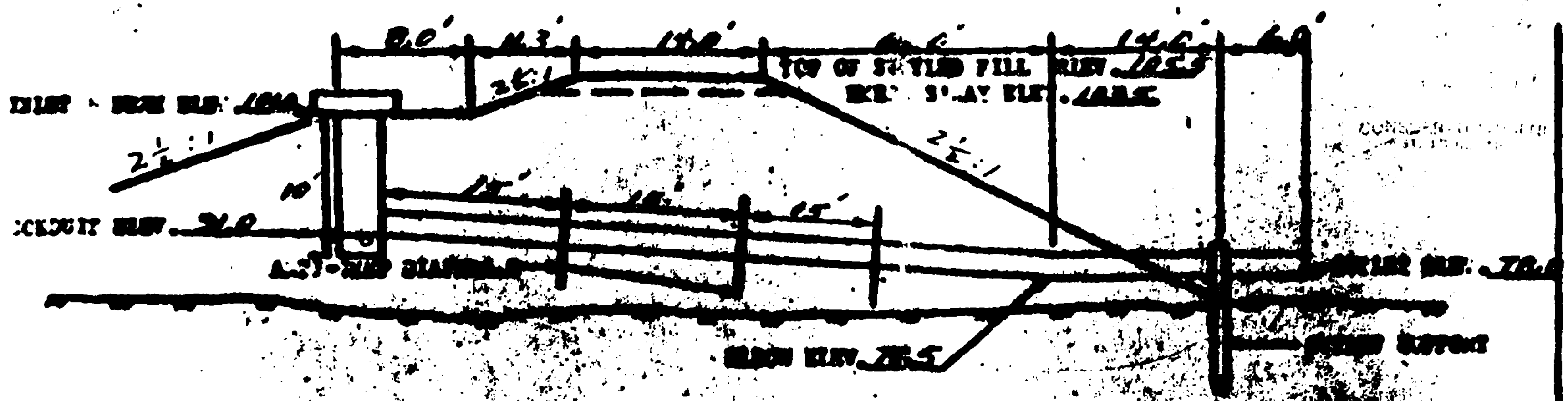


LOCATION MAP - DR. COURTNEY DAM

DR. COURTNEY DAM (MO. 30017)
PLAN AND ELEVATION



SCALE:
1"=100' (HORIZONTAL)
VERTICAL (NOT TO SCALE)



PRELIMINARY DIMENSIONS AND QUANTITY ESTIMATES

BENCH MARK DESCRIPTION:

Elev. 100.00 Nail in base of ... Black Oak ... 100' NE of ...

PIPE
LENGTH 44 FT. SIZE ... TYPE ...
LENGTH 10 FT. SIZE ... TYPE ...
ANTI-VORTEX SIZE ... TYPE ...
ANTI-SEEP DIAPHRAGM NO. ... SIZE ... TYPE ...
ESTIMATE OF EARTH FILL ...
APPROX POOL SIZE ... Trashrack Req'd.

ENGINEER MAKING ESTIMATE ... DATE ...

NOTES AND COMMENTS:

Final design ... will follow ... can be ...

Recommend area be ... by ... before construction begins

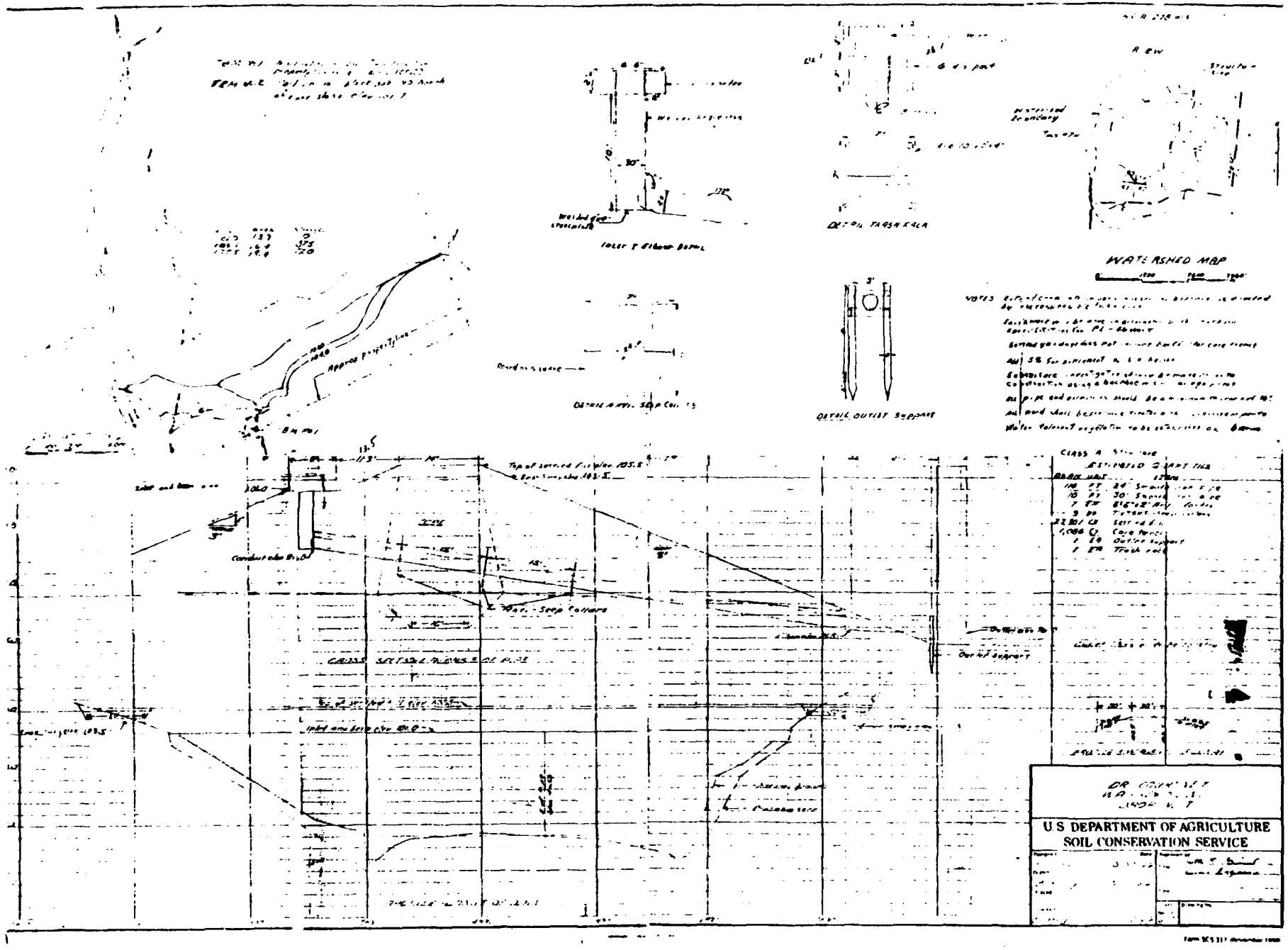
NAME DR. ... COUNTY ...
SEC. 29 TWP. ... RGE ...

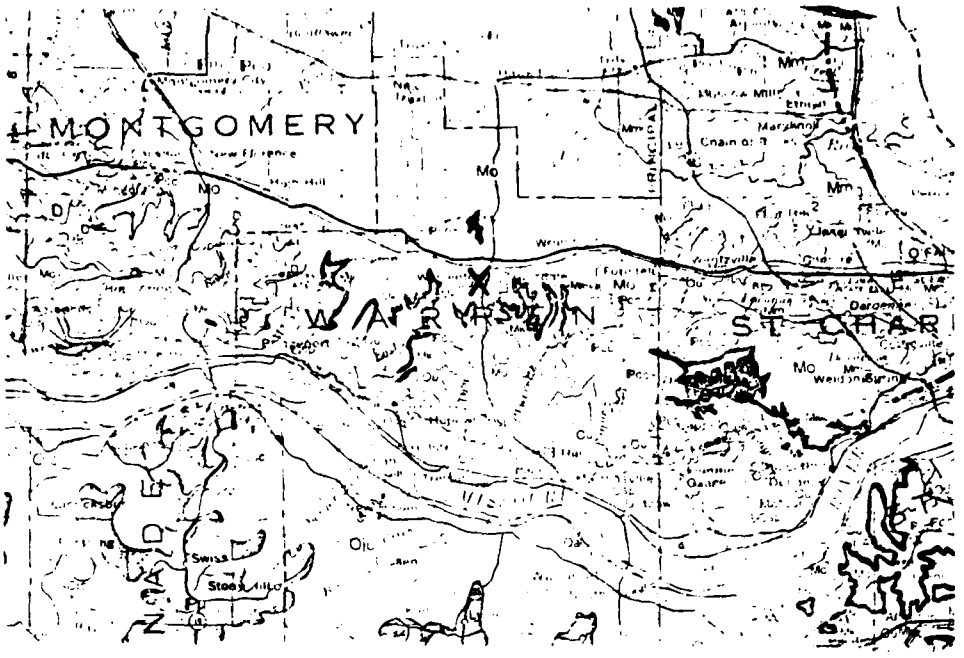
UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PRELIMINARY INFORMATION FOR STRUCTURES

NOT TO BE USED FOR CONSTRUCTION

3


WATERSHED MAP
DETAIL OUTLET SUPPORT
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE



QUARTERNARY { Qal - ALLUVIUM

PENNSYLVANIAN {
- Pm - MARMATON GROUP
- Pcc - CHEROKEE GROUP

MISSISSIPPIAN {
- Mm - ST LOUIS LIMESTONE
  SALEM FORMATION
  WARSAW FORMATION
- Mo - BURLINGTON-KEOKUK FORMATION
- Mk - CHOTEAU GROUP

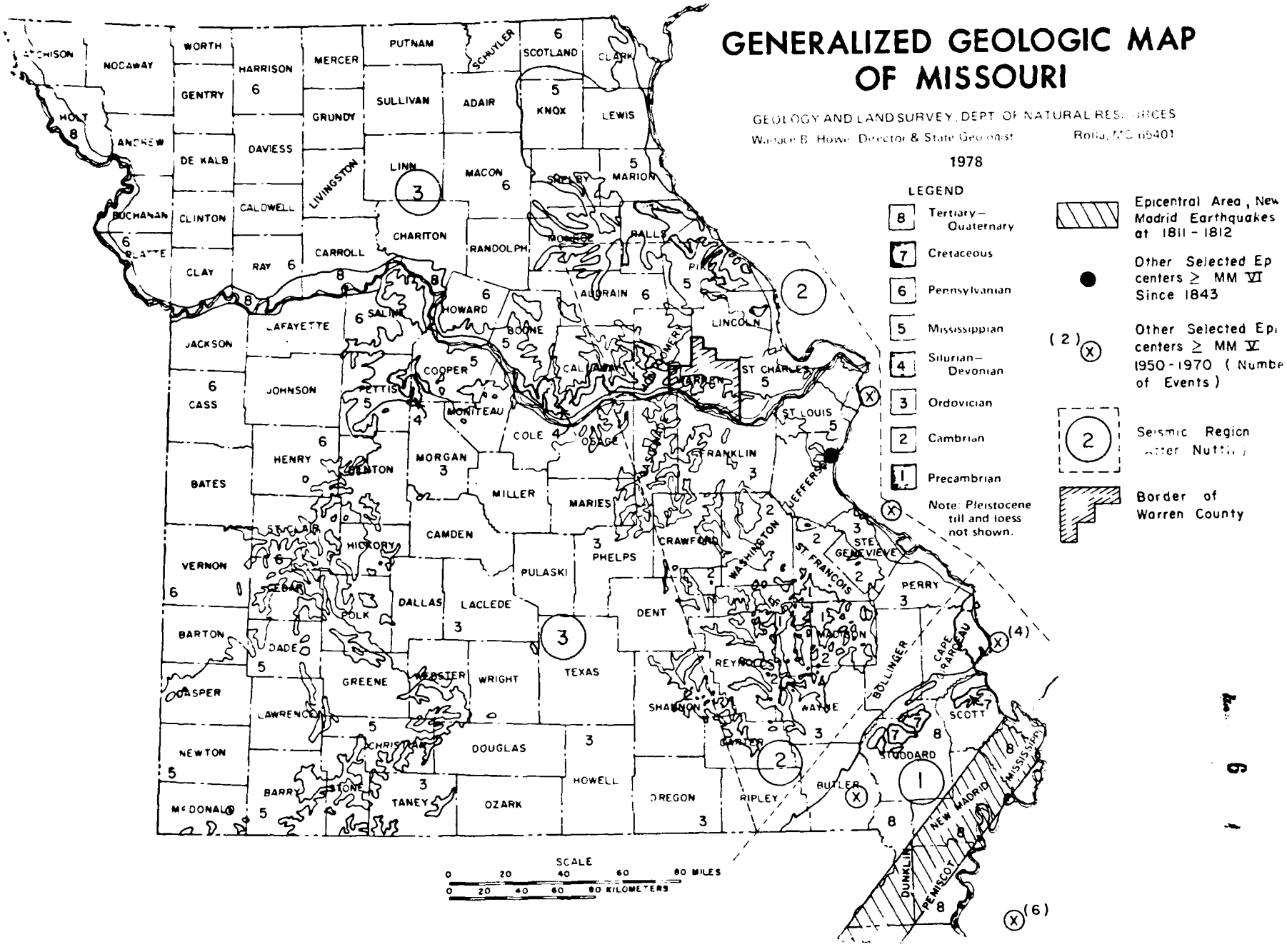
ORDOVICIAN {
- Ou - NOIX LIMESTONE
  MAQUOKETA SHALE
  CAPE LIMESTONE
  KIMMSWICK FORMATION
  DECORAH FORMATION
  PLATTIN FORMATION
  JOACHIM DOLOMITE
- Osp - ST. PETER SANDSTONE
- Ojc - COTTER-POWELL FORMATION
  JEFFERSON CITY DOLOMITE

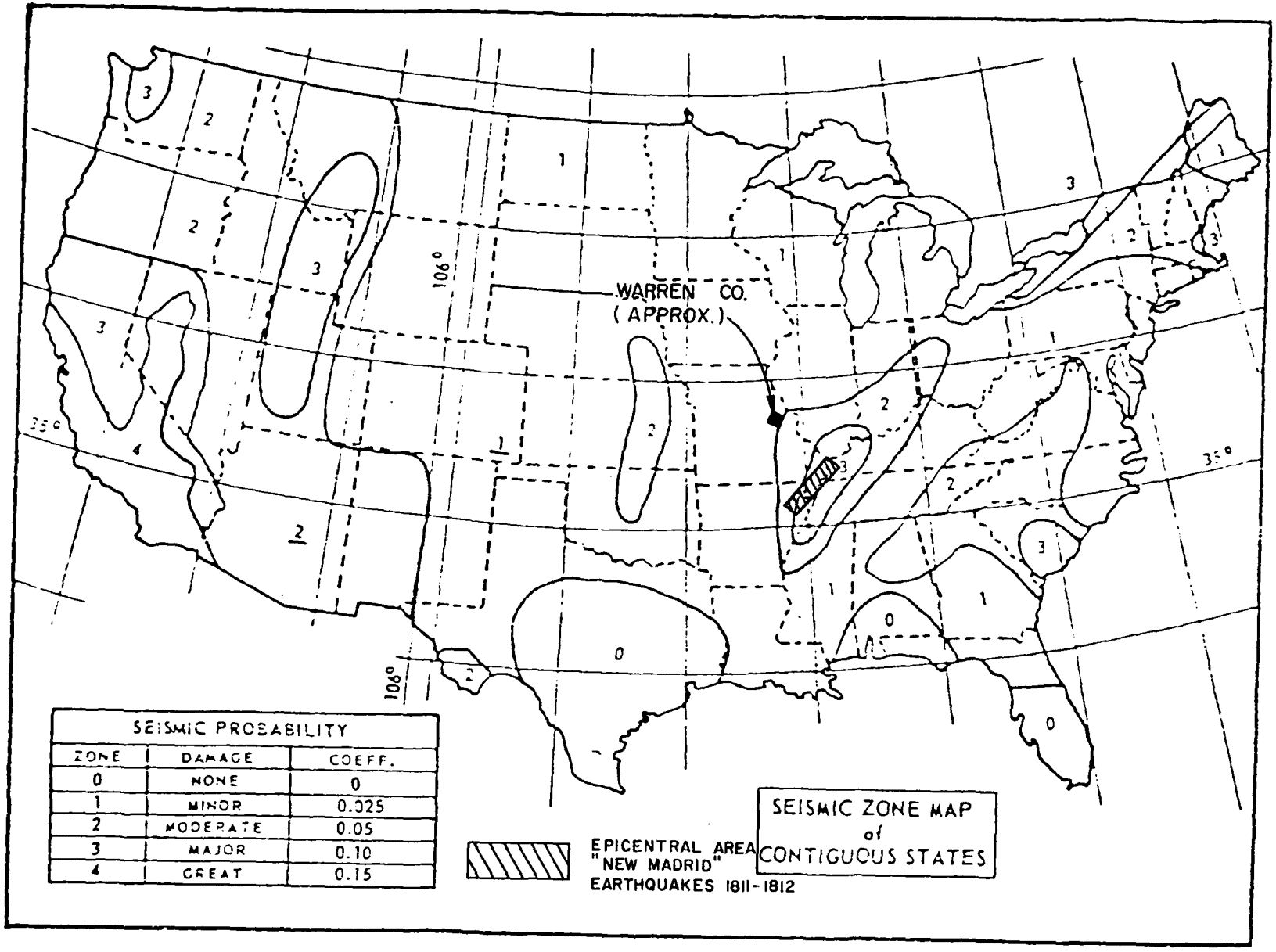
X LOCATION OF DAM MO. 30017

REFERENCE
GEOLOGIC MAP OF MISSOURI, MISSOURI GEOLOGIC SURVEY, 1979.

10 0 10
SCALE OF MILES

GEOLOGIC MAP OF WARREN COUNTY AND ADJACENT AREA


GENERALIZED GEOLOGIC MAP OF MISSOURI
GEOLOGY AND LAND SURVEY, DEPT OF NATURAL RESOURCES
Wallace B. Howe, Director & State Geologist
Rolla, MO 65401
1978
LEGEND
8 Tertiary–Quaternary
7 Cretaceous
6 Pennsylvanian
5 Mississippian
4 Silurian–Devonian
3 Ordovician
2 Cambrian
1 Precambrian
Note: Pleistocene till and loess not shown.
Epicentral Area, New Madrid Earthquakes at 1811 - 1812
Other Selected Ep centers ≥ MM VI Since 1843
(2) Other Selected Epi centers ≥ MM V 1950 - 1970 (Numbe of Events)
2 Seismic Region
Border of Warren County
SCALE
0 20 40 60 80 MILES
0 20 40 60 80 KILOMETERS
ATCHISON
NODAWAY
WORTH
HARRISON
MERCER
PUTNAM
SCHUYLER
SCOTLAND
CLARK
GENTRY
GRUNDY
SULLIVAN
ADAIR
KNOX
LEWIS
HOLT
ANDREW
DE KALB
DAVIESS
LIVINGSTON
LINN
MACON
SHELBY
MARION
BUCHANAN
CLINTON
CALDWELL
CHARITON
RANDOLPH
MONROE
PIKE
PLATTE
CLAY
RAY
CARROLL
HOWARD
AUDRAIN
LINCOLN
SALINE
LAFAYETTE
BOONE
JACKSON
COOPER
CALLAWAY
MONTGOMERY
WARREN
ST CHARLES
JOHNSON
PETTIS
MONITEAU
ST LOUIS
CASS
COLE
OSAGE
HENRY
BENTON
MORGAN
FRANKLIN
BATES
MILLER
MARIES
JEFFERSON
CAMDEN
CRAWFORD
STE GENEVIEVE
ST FRANCOIS
VERNON
HICKORY
PHELPS
WASHINGTON
PERRY
CEDAR
PULASKI
DALLAS
LACLEDE
DENT
POLK
BARTON
DADE
MADISON
CAPE GIRARDEAU
BOLLINGER
GREENE
WEBSTER
WRIGHT
TEXAS
REYNOLDS
SCOTT
JASPER
LAWRENCE
SHANNON
WAYNE
CARTER
STODDARD
NEWTON
CHRISTIAN
DOUGLAS
HOWELL
BARRY
STONE
TANEY
OZARK
OREGON
RIPLEY
BUTLER
MISSISSIPPI
McDONALD
NEW MADRID
DUNKLIN
PEMISCOT
(4)
(6)


WARREN CO.
(APPROX.)
106°
35°
SEISMIC PROBABILITY
ZONE | DAMAGE | COEFF.
0 | NONE | 0
1 | MINOR | 0.025
2 | MODERATE | 0.05
3 | MAJOR | 0.10
4 | GREAT | 0.15
EPICENTRAL AREA "NEW MADRID" EARTHQUAKES 1811-1812
SEISMIC ZONE MAP of CONTIGUOUS STATES

APPENDIX A

PHOTOGRAPHS TAKEN DURING INSPECTION

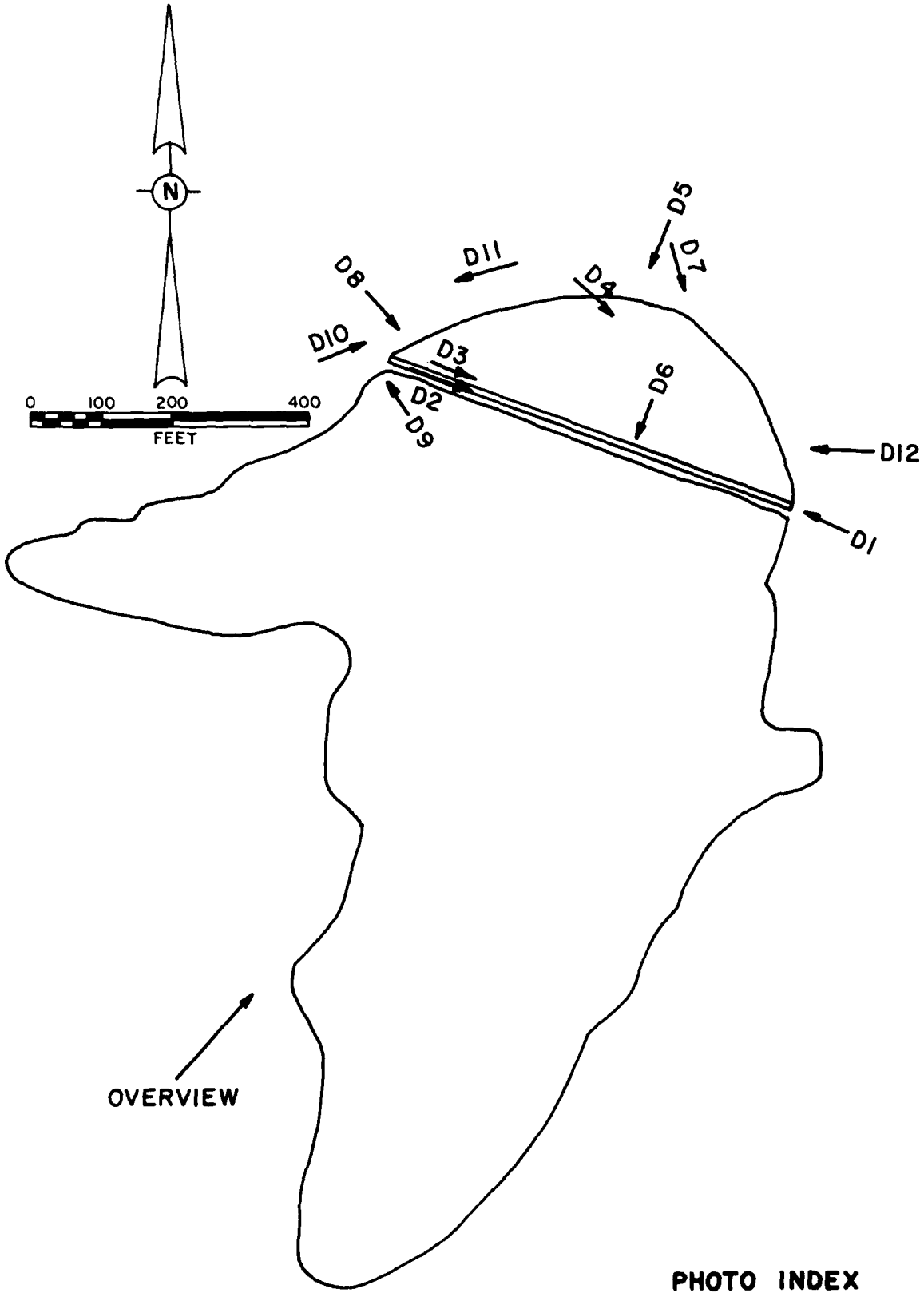


PHOTO INDEX
FOR
DR. COURTNEY DAM

DR. COURTNEY DAM

D1 - Crest of Embankment

D2 - Crest of Embankment

D3 - Downstream Embankment Slope

D4 - Pit Housing Gate Valve

D5 - Discharge End of C.M.P. Drain Pipe

D6 - Intake of Service Spillway

D7 - Discharge of Service Spillway

D8 - Emergency Spillway Crest

D9 - Emergency Spillway Crest

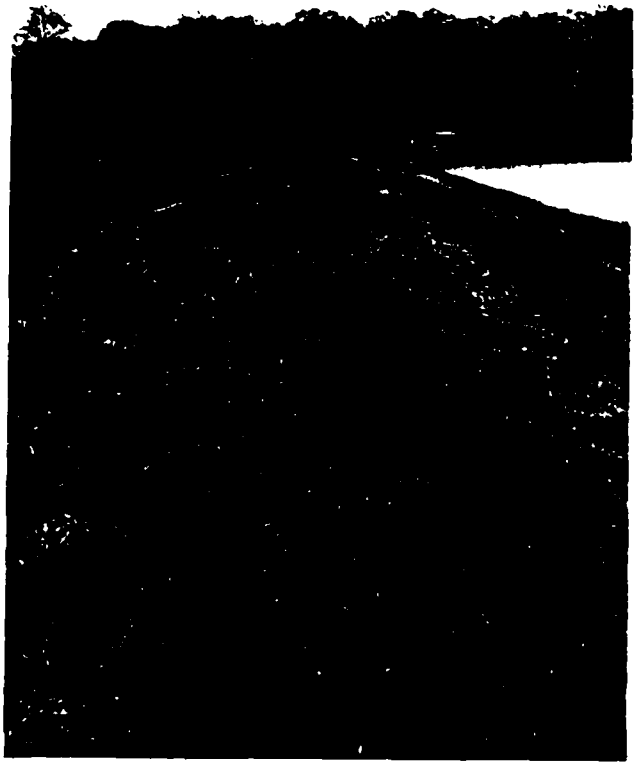
D10 - Emergency Spillway Discharge Channel

D11 - Emergency Spillway Discharge Channel

D12 - Downstream Embankment Slope

D1

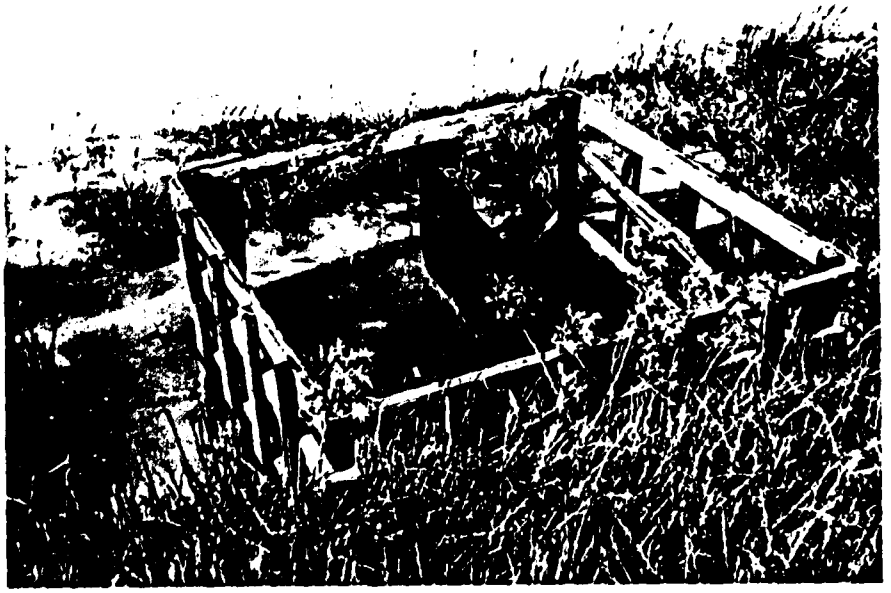
D2



D3

D4

D5



D6

D7

D8

D9

D10

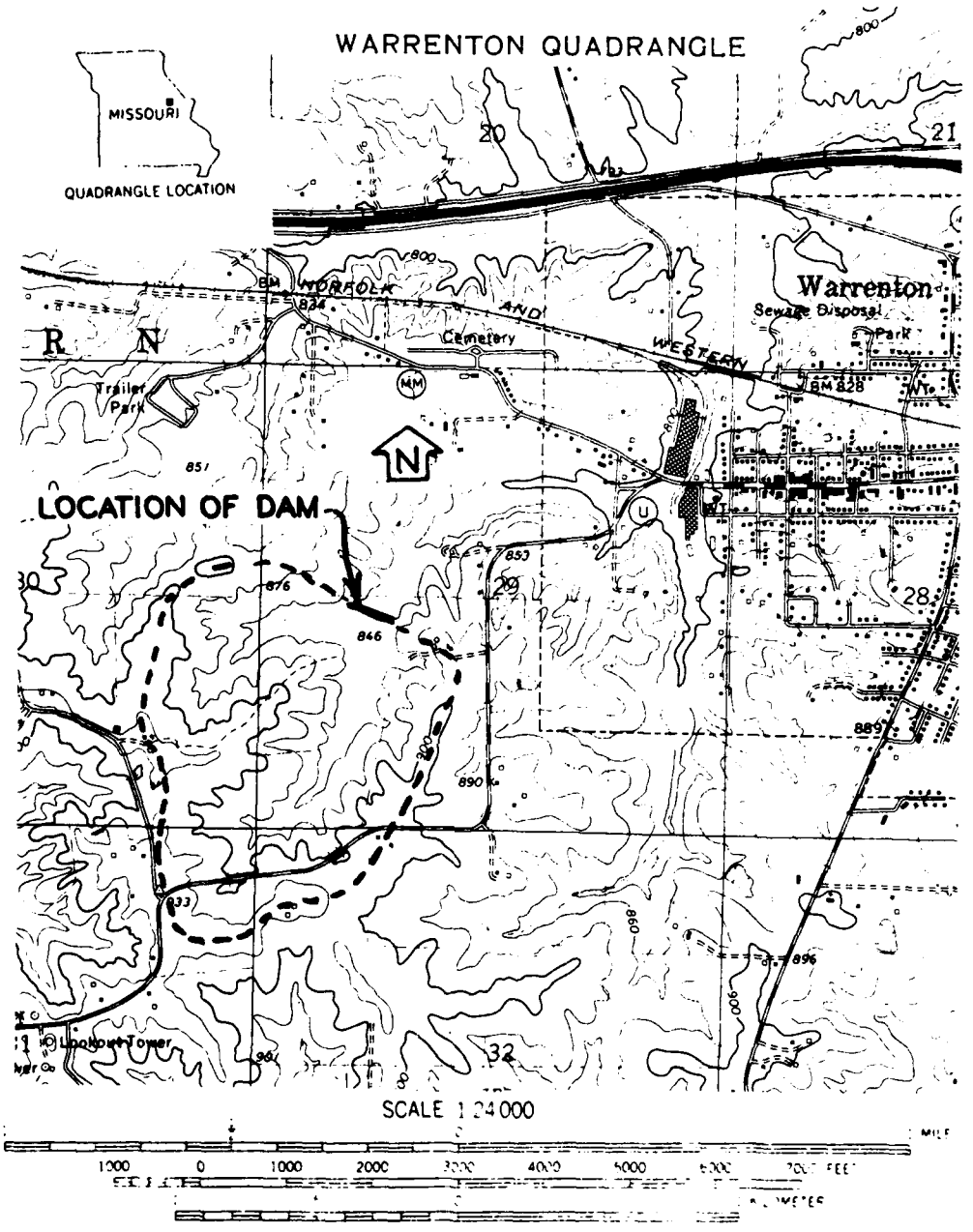
D11

D12

APPENDIX B

HYDROLOGIC COMPUTATIONS

PLATE 2, APPENDIX C



DR. COURTNEY DAM (MO. 30017)
DRAINAGE BASIN

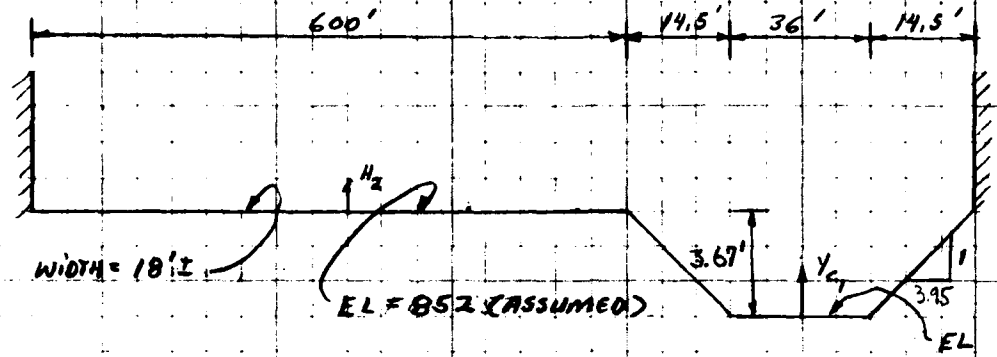
ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION - MISSOURI SHEET NO. 1 OF

MISSOURI DAM 30017 JOB NO. 1240-001-1

EMERGENCY SPILLWAY AND OVERTOP RATING CURVE BY MLB DATE 5-21-79

M.C.M.



CRITICAL DEPTH ASSUMED IN SPILLWAY SECTION

Y_{c_1} (Ft)	A_{c_1} (Ft^2)	T_{c_1} (Ft)	$V_{o_1} = 5.67\sqrt{\frac{A_{c_1}}{T_{c_1}}}$	$\frac{V_{c_1}^2}{2g}$	$Q_{c_1} = A_{c_1} \cdot V_{c_1}$	u/s w.s. $= \frac{V_{c_1}^2}{2g} + Y_{c_1}$	H_2	C_2	L_2	$Q_2 = C_2 L_2 H_2^{3/2}$	$Q_T = Q_{c_1} + Q_2$
0	0	36	0	0	0	848.3	–	–	–	–	0
1	39.95	43.90	5.41	.45	216.13	849.75	–	–	–	–	216.13
2	87.80	51.80	7.38	.85	647.96	851.15	–	–	–	–	647.96
3	143.55	59.70	8.79	1.20	1262.12	852.50	.5	2.70	600	572.76	1834.88
3.67	185.34	65.0	9.57	1.42	1773.70	853.39	1.39	2.64	600	2595.8	4369.5
4.5	239.29	65.0	10.88	1.84	2603.18	854.64	2.64	2.63	600	6768.82	9372.3

ECI-4

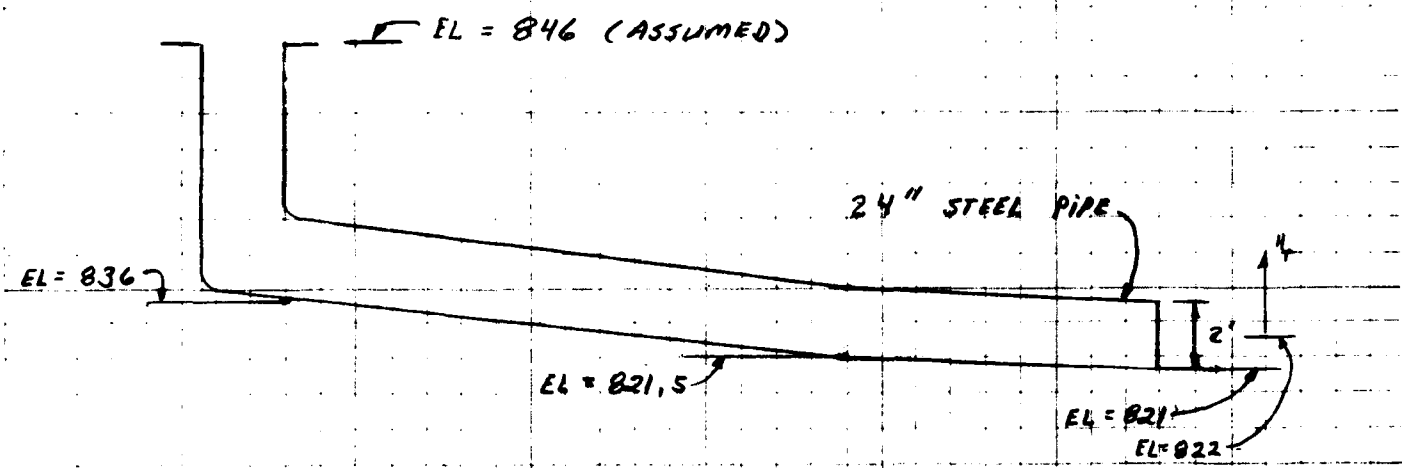
ECI-4 ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION - MISSOURI — SHEET NO. 1 OF _____

MISSOURI DAM 30017 — JOB NO. 1240-001-1

DROP INLET SPILLWAY RATING CURVE. — BY KLB M.R.H. ✓ DATE 5-22-79

DROP INLET SPILLWAY



SPILLWAY DISCHARGE (ASSUME NO TAILWATER EFFECT.)

AT W.L. 847.:

a) WEIR FLOW:

ASSUME $C = 3.0$

$Q = C L H^{3/2} = 3.0 \times \pi(2.5) \times 1^{3/2}$

$Q = 23.56$ CFS.

b) PRESSURE FLOW:

$$H_T = \left(1 + K_e + f \frac{L}{D}\right) \frac{V^2}{2g}$$

ASSUME $K_e = 0.10$

& $f = 0.027$ FOR $n = 0.016$

b) WL = 847 (CONT.)

$$\therefore H_T = \left(1 + .10 + 0.027 \frac{110.3}{2}\right)\frac{V^2}{2g}$$

$$= 2.59 \frac{V^2}{2g}$$

$$V = \sqrt{\frac{2g\ H_T}{2.59}}$$

$$V = 4.99 \sqrt{H_T}$$

$$Q = A \cdot V = \pi \times 1^2 \times 4.99 \sqrt{H_T}$$

$$Q = 15.67 \sqrt{H_T}$$

$$H_t = 847 - 822 = 25$$

$$Q = 15.67 \sqrt{25} = 78.33 > 23.56$$

$$\therefore Q = 23.56 \text{ CFS} \quad AT \quad WL = 847$$

WL = 848 $\quad H_t = 848 - 822 = 26$

a) WEIR FLOW

$$Q = CLH^{3/2} = 3.0 \times \pi \times 2.5 \times 2^{3/2}$$

$$Q = 66.64 \text{ CFS.}$$

b) PRESSURE FLOW.

$$Q = 15.67 \sqrt{H_T} = 15.67 \sqrt{26}$$

$$Q = 79.90 > 66.64 \Rightarrow \text{USE } 66.64$$

ECI-4 ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION - MISSOURI
MISSOURI DAM 30017
DROP INLET RATING CURVE.

SHEET NO. 3 OF
JOB NO. 1240-001-1
BY KLB M.P.H.✓ DATE 5-22-79

WL = 848.3 H_t = 848.3-822 = 26.3

a) WEIR FLOW

$Q = CLH^{3/2} = 3.0 \times \pi \times 2.5 \times 2.3^{3/2}$

Q = 82.19

b) PRESSURE FLOW

$Q = 15.67\sqrt{H_t} = 15.67\sqrt{26.3}$

Q = 80.36 < 82.19

∴ USE 80.36 CFS.

∴ USE EQ: $Q = 15.67\sqrt{H_t}$

FOR ALL ELEVATIONS ABOVE 849.

ECI-4 ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION - MISSOURI SHEET NO. 1 OF

MISSOURI DAM 30017 JOB NO. 1240-001-1

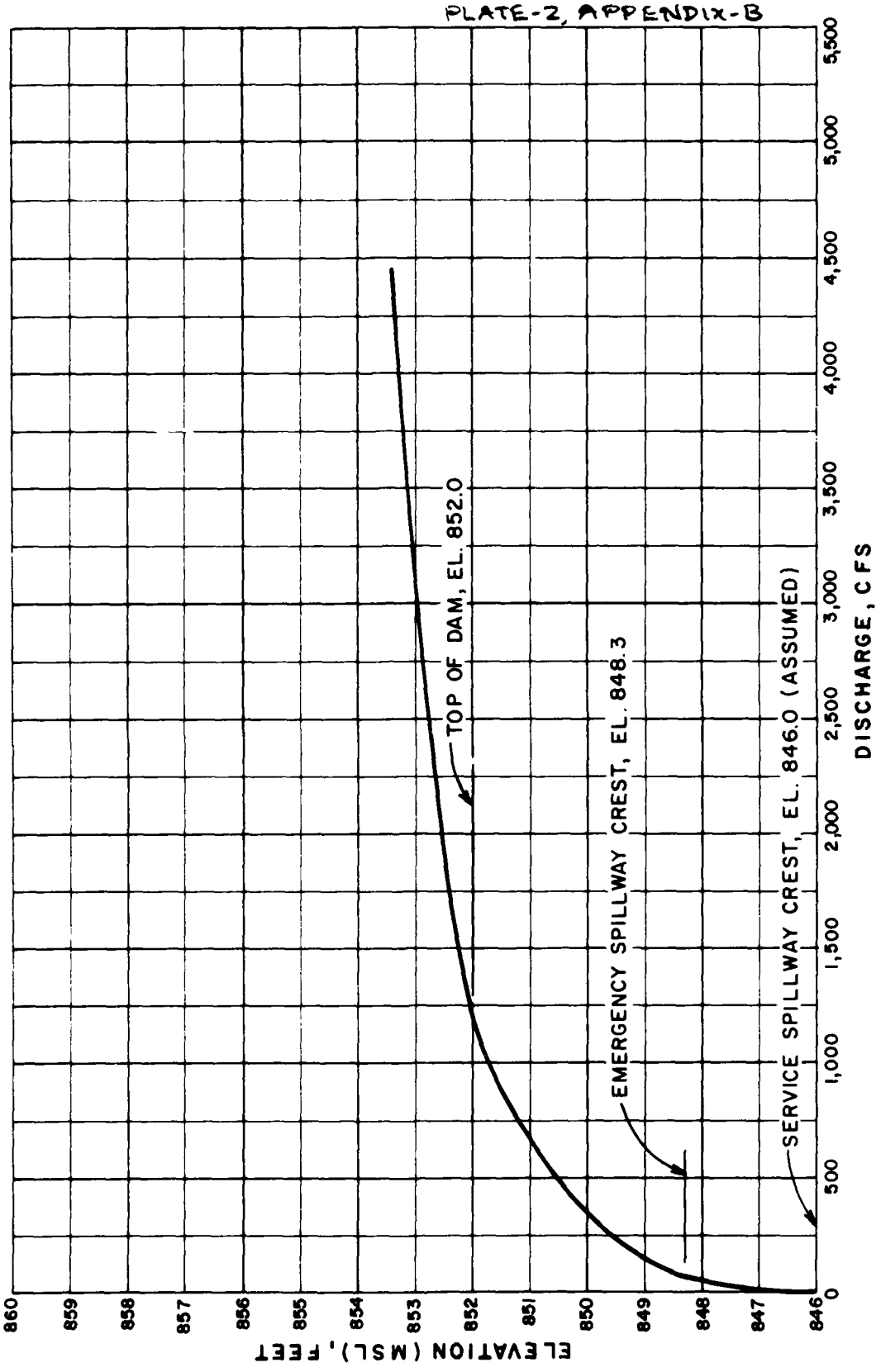
COMBINED SPILLWAY AND OVERTOP BY KLB M.R.H. DATE 6-22-79

RATING CURVES.

RESERVOIR WATER SURFACE ELEV.	HEAD ON DROP INLET SPILLWAY (FT) H_t	DROP INLET SPILLWAY DISCHARGE $Q = 15.67\sqrt{H_t}$	EMERGENCY SPILLWAY DISCHARGE (CFS)	OVERTOP DISCHARGE (CFS)	COMBINED DISCHARGE (CFS)
846	24	–	–	–	0
847	25	*23.6	–	–	24
848	26	*66.6	–	–	67
848.3	26.3	80.4	0	–	80.
849.75	27.75	82.55	216.3	–	299
851.15	29.15	84.60	647.96	–	733
852.50	30.50	86.54	1262.12	572.76	1921
853.39	31.39	87.79	1773.70	2595.8	4452
854.64	32.64	89.52	2603.48	6768.82	9462

* WEIR FLOW CONTROLS

PLATE-2, APPENDIX-B



DR. COURTNEY DAM (MO. 30017)
SPILLWAY & OVERTOP RATING CURVE

ECI-4 ENGINEERING CONSULTANTS, INC.

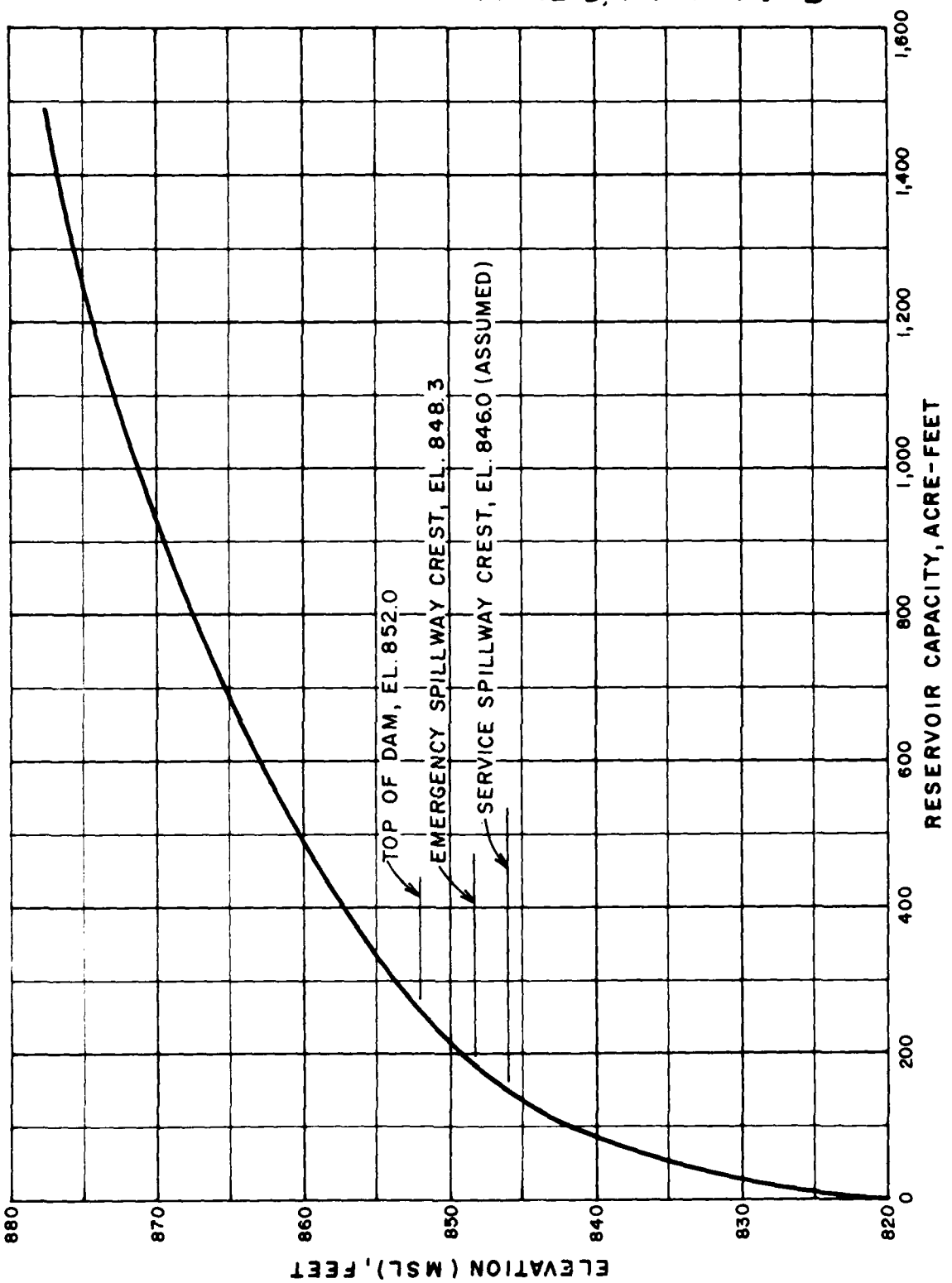
Dam Safety Inspection - Missouri SHEET NO. 1 OF
Dr. Courtney Dam #30017 JOB NO. 1246-001-1
Reservoir Area Capacity BY M.R.N. DATE 5-15-79

Dr. Courtney

Reservoir Area Capacity

Elev. M.S.L. (Ft.)	Reservoir Surface Area (Acres)	Incremental Volume (Ac.-Ft.)	Total Volume (Ac.-Ft.)	Remarks
822	0	0	0	Est. Streambed at Center of Dam
846	18	144	144	Spillway Crest Elev. (From U.S.G.S. map)
848.3	20.5	44.2	188.2	Emergency Spillway Crest
852	24	66.7	254.9	Top of Dam
860	35	235	490	Area measured on U.S.G.S. map.
880	96	1260	1750	Area measured on U.S.G.S. map.

PLATE-3, APPENDIX-B



DR. COURTNEY DAM (MO. 30017)
RESERVOIR CAPACITY CURVE

ECI-4 ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION / MISSOURI — SHEET NO. 1 OF
DAM # MO 30017 — JOB NO. 1240-001
PROBABLE MAXIMUM PRECIPITATION — BY MAS DATE 5/22/79

DAM NO MO 30017

DETERMINATION OF PMP

1. Determine drainage area of the basin

   D.A. = 278 Ac = .043 Sq. Mi.

2. Determine PMP Index Rainfall

   Location of centroid of basin:

   Long. = 91°10'12", Lat. = 38°48'10" ⇒ PMP = 24" (From Fig. 1 HMR NO. 33)

3. Determine basin rainfall in terms of percentage of PMP Index Rainfall for various durations:

   Location: Long. = 91°10'12", Lat. = 38°48'10"

   ⇒ Zone 7

Duration (Hrs.)	Percent of Index Rainfall (%)	Total Rainfall (inches)	Rainfall Increments (inches)	Duration of Increment (Hrs.)
6	100	24	24	6
12	120	28.8	4.8	6
24	130	31.2	2.4	12

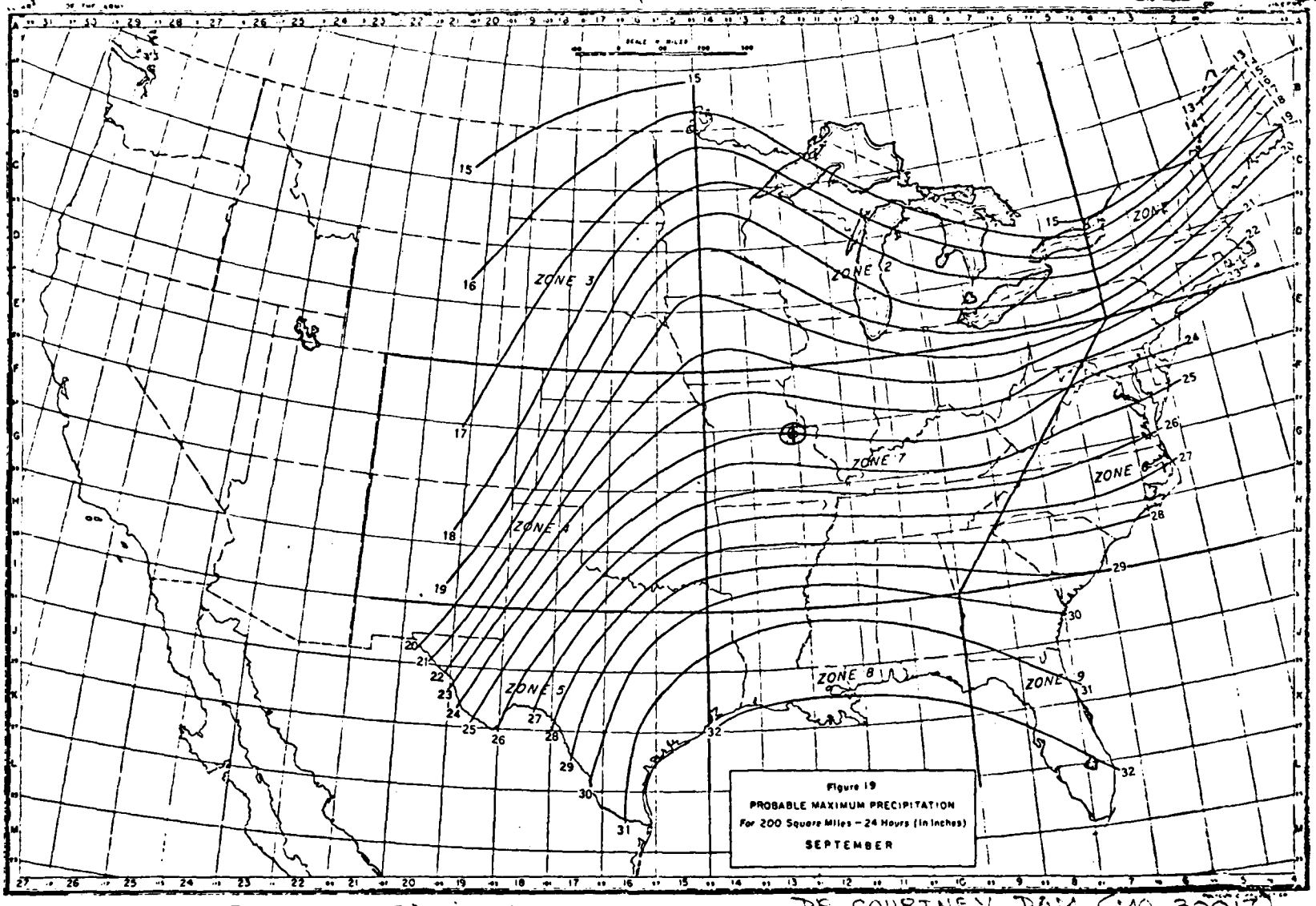


Figure 19
PROBABLE MAXIMUM PRECIPITATION
For 200 Square Miles – 24 Hours (in inches)
SEPTEMBER

PMP FOR 200 SQ.MI - 24 HRS
DURATION = 24"

DR. COURTNEY DAM (10.300.17)
LOCATION OF CENTROID OF WATERSHED
LAT. = 39°48'10" LONG = 91°10'15"

DR COURTNEY

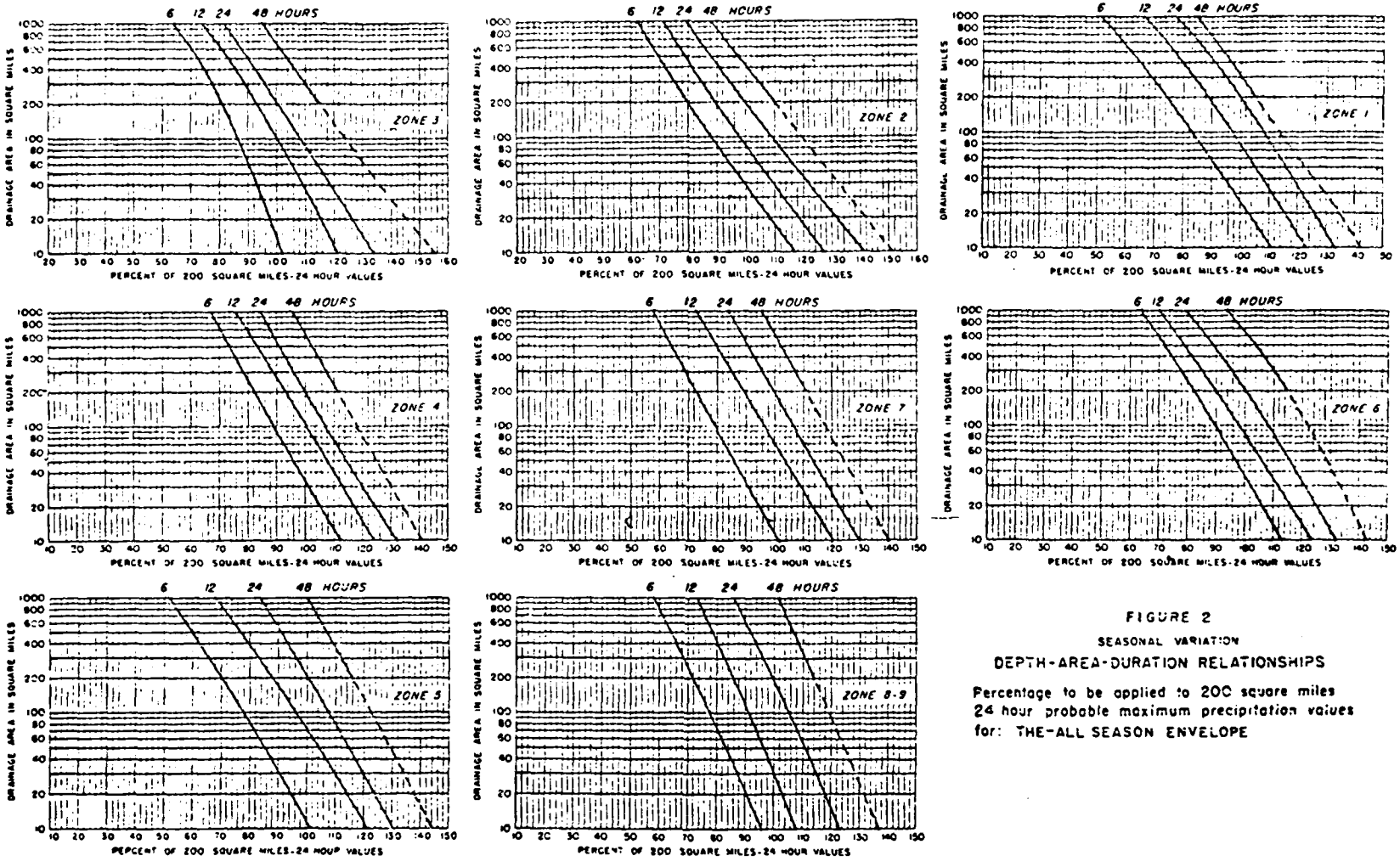


FIGURE 2

SEASONAL VARIATION

DEPTH-AREA-DURATION RELATIONSHIPS

Percentage to be applied to 200 square miles 24 hour probable maximum precipitation values for: THE-ALL SEASON ENVELOPE

EC-4 ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION - MISSOURI — SHEET NO. 1 OF ____
DR COURTNEY DAM # 30017 — JOB NO. 1240-001-1
UNIT HYDROGRAPH PARAMETERS — BY KLB DATE 5-29-79

1. DRAINAGE AREA = 278 ACRES = 0.43 SQ. MI.

2. LENGTH OF STREAM = (1.50" X 2000' = 3000') = 0.57 MI.

3. ELEVATION OF DRAINAGE DIVIDE ALONG THE LONGEST STREAM, $H_1 = 933'$

4. RESERVOIR ELEVATION AT THE SPILLWAY CREST, $H_2 = 846'$

5. DIFFERENCE IN ELEVATION, $\Delta H = 933 - 846 = 87'$

6. AVERAGE SLOPE OF STREAM = $\frac{\Delta H}{L} = \frac{87}{3000'} = 2.9\%$

7. TIME OF CONCENTRATION:

a) BY KIRPICH FORMULA.

$$T_c = \left(\frac{11.9 \times L^3}{\Delta H}\right)^{0.385} = \left(\frac{11.9 \times 0.57^3}{87'}\right)^{0.385} = 0.24 \text{ HR}$$

b) BY VELOCITY ESTIMATE.

SLOPE = 2.9% ⇒ AVERAGE VELOCITY = 3 FPS

$$\therefore T_c = \frac{0.57 \times 5280}{3 \times 60 \times 60} = 0.28 \text{ HR}$$

USE $T_c = 0.26$ HR.

8. LAG TIME, $L_t = 0.6 \times 0.26 = 0.156$

9. UNIT DURATION $D \leq \frac{L_t}{3} = \frac{0.156}{3} = 0.052 < 0.083$

USE $D = 0.083 = 5$ MIN.

10. TIME TO PEAK, $T_p = \frac{D}{2} + L_t = \frac{0.083}{2} + 0.156$

$T_p = 0.196$

11. PEAK DISCHARGH, $q_p = \frac{484 \cdot A}{T_p} = \frac{484 \times (0.43)}{0.196}$

$q_p = 1062$ CFS

ECI-4 ENGINEERING CONSULTANTS, INC.

DAM SAFETY INSPECTION / MISSOURI SHEET NO. 1 OF 1
DAM # MO. 30017 JOB NO. 1240-001
DETERMINATION OF SOIL GROUP & CURVE NUMBER BY MAS DATE 5/31/79

MISSOURI DAM # MO. 30017

DETERMINATION OF HYDROLOGIC SOIL GROUP & SCS CURVE NUMBER

1. Watershed Soils consist of mainly D group Soils.
   Assume Soil Group 'D' for the whole watershed.

2. About 50 percent of the watershed is wooded land. Assume 'Fair' hydrologic condition for infiltration purpose.
   Thus CN = 79 for Soil Group D & AMC-II
   $\Rightarrow$ CN = 91 for AMC-III.

HEC1DB INPUT DATA

```
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  26 FEB 79
```

```
     1                A
     2                A                    DAM SAFETY INSPECTION - MISSOURI
                      A                    DR COURTNEY DAM  (30017)
     3                A          PMF AND 50 PERCENT PMF DETERMINATION AND ROUTING
     4                B   300      0       5       0       0       0       0       0       0       0
     5                B1    5
     6                J     1      2       1
     7                J1  1.0    0.5
     8                K     0  30017                                       1
     9                KI  INPUT INDEX PRECIPITATION AND RATIOS, INPUT SCS UNIT HYDROGRAPH PARAMETERS
    10                M     1      2    0.43            0.83    1.0
    11                P           24.0    100     120     130
    12                T                                                  -1   -91.0
    13                M2          0.156
    14                J     0      0       1
    15                K     1  30017                   2                1
    16                KI  ROUTE HYDROGRAPH THROUGH DR COURTNEY DAM
    17                Y                             1       1
    18                Y1    1                                          -846.0     -1
    19                Y4  846.0   847.0   848.0   848.3   849.75  851.15  852.00  852.50  853.39  854.64
    20                Y5    0.      24.     67.     80.     209.    733.   1146.    1921.   4457    9462.
    21                I     0.     144.    184.2   254.9   490.   1750.
    22                IE  822.    846.    848.3   852.0   860.    880.
    23                KK  846.
    24                KD  852.
    25                K   99
```

INFLOW PMF AND ONE-HALF PMF HYDROGRAPHS

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	30047
ROUTE HYDROGRAPH TO	30017
END OF NETWORK	

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********

 RUN  DATE= 79/06/14.
      TIME= 07.29.02.
```

DAM SAFETY INSPECTION - MISSOURI
DR COURTNEY DAM (30017)
PMF AND 50 PERCENT PMF DETERMINATION AND ROUTING

JOB SPECIFICATION

NQ	NDAY	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	5	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 2 LRTIO= 1

RTIO = 1.00 .50

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INPUT INDEX PRECIPITATION AND RATIOS, INPUT SCS UNIT HYDROGRAPH PARAMETERS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
30017	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.43	0.00	.43	1.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.00	100.00	120.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-91.00	0.00	0.00

CURVE NO = -91.00 WETNESS = -1.00 EFFECT CN = -91.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .26

RECESSION DATA
STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

TIME INCREMENT TOO LARGE--(NMIN IS 57 LAG/2)

UNIT HYDROGRAPH 12 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .58 VOL= 1.00

	512.	1024.	768.	512.	256.	128.	64.	32.	16.	8.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	0.	1.01	12.35	151	.20	.20	.00	646.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.40	152	.20	.20	.00	651.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.45	153	.20	.20	.00	653.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.50	154	.20	.20	.00	655.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.55	155	.20	.20	.00	656.
1.01	.30	6	.01	0.00	.01	0.	1.01	13.00	156	.20	.20	.00	656.
1.01	.35	7	.01	0.00	.01	0.	1.01	13.05	157	.24	.24	.00	671.
1.01	.40	8	.01	0.00	.01	0.	1.01	13.10	158	.24	.24	.00	712.
1.01	.45	9	.01	0.00	.01	0.	1.01	13.15	159	.24	.24	.00	749.
1.01	.50	10	.01	0.00	.01	0.	1.01	13.20	160	.24	.24	.00	770.
1.01	.55	11	.01	0.00	.01	0.	1.01	13.25	161	.24	.24	.00	780.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.30	162	.24	.24	.00	786.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.35	163	.24	.24	.00	787.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.40	164	.24	.24	.00	790.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.45	165	.24	.24	.00	791.
1.01	1.20	16	.01	.00	.01	0.	1.01	13.50	166	.24	.24	.00	792.
1.01	1.25	17	.01	.00	.01	0.	1.01	13.55	167	.24	.24	.00	792.
1.01	1.30	18	.01	.00	.01	1.	1.01	14.00	168	.24	.24	.00	793.
1.01	1.35	19	.01	.00	.01	2.	1.01	14.05	169	.30	.30	.00	815.
1.01	1.40	20	.01	.00	.01	3.	1.01	14.10	170	.30	.30	.00	875.
1.01	1.45	21	.01	.00	.01	4.	1.01	14.15	171	.30	.30	.00	931.
1.01	1.50	22	.01	.00	.01	5.	1.01	14.20	172	.30	.30	.00	962.
1.01	1.55	23	.01	.00	.01	6.	1.01	14.25	173	.30	.30	.00	977.
1.01	2.00	24	.01	.00	.01	7.	1.01	14.30	174	.30	.30	.00	985.
1.01	2.05	25	.01	.00	.01	8.	1.01	14.35	175	.30	.30	.00	989.
1.01	2.10	26	.01	.00	.01	9.	1.01	14.40	176	.30	.30	.00	991.
1.01	2.15	27	.01	.00	.01	10.	1.01	14.45	177	.30	.30	.00	992.
1.01	2.20	28	.01	.00	.01	10.	1.01	14.50	178	.30	.30	.00	993.
1.01	2.25	29	.01	.00	.01	11.	1.01	14.55	179	.30	.30	.00	994.
1.01	2.30	30	.01	.00	.01	12.	1.01	15.00	180	.30	.30	.00	994.
1.01	2.35	31	.01	.00	.01	13.	1.01	15.05	181	.18	.18	.00	951.
1.01	2.40	32	.01	.00	.01	13.	1.01	15.10	182	.36	.36	.00	889.
1.01	2.45	33	.01	.00	.01	14.	1.01	15.15	183	.36	.36	.00	874.
1.01	2.50	34	.01	.00	.01	15.	1.01	15.20	184	.55	.55	.00	1124.
1.01	2.55	35	.01	.01	.01	15.	1.01	15.25	185	.64	.64	.00	1431.
1.01	3.00	36	.01	.01	.01	16.	1.01	15.30	186	1.55	1.55	.00	2057.
1.01	3.05	37	.01	.01	.01	17.	1.01	15.35	187	2.55	2.55	.01	3538.
1.01	3.10	38	.01	.01	.01	17.	1.01	15.40	188	1.00	1.00	.00	4941.
1.01	3.15	39	.01	.01	.01	18.	1.01	15.45	189	.64	.64	.00	4688.
1.01	3.20	40	.01	.01	.01	18.	1.01	15.50	190	.55	.55	.00	3596.
1.01	3.25	41	.01	.01	.01	19.	1.01	15.55	191	.36	.36	.00	2704.
1.01	3.30	42	.01	.01	.01	19.	1.01	16.00	192	.36	.36	.00	2058.
1.01	3.35	43	.01	.01	.01	20.	1.01	16.05	193	.28	.28	.00	1608.
1.01	3.40	44	.01	.01	.01	20.	1.01	16.10	194	.28	.28	.00	1310.
1.01	3.45	45	.01	.01	.01	21.	1.01	16.15	195	.28	.28	.00	1124.
1.01	3.50	46	.01	.01	.01	21.	1.01	16.20	196	.28	.28	.00	1028.
1.01	3.55	47	.01	.01	.01	22.	1.01	16.25	197	.28	.28	.00	976.
1.01	4.00	48	.01	.01	.01	22.	1.01	16.30	198	.28	.28	.00	949.
1.01	4.05	49	.01	.01	.01	23.	1.01	16.35	199	.28	.28	.00	938.
1.01	4.10	50	.01	.01	.01	23.	1.01	16.40	200	.28	.28	.00	934.
1.01	4.15	51	.01	.01	.01	23.	1.01	16.45	201	.28	.28	.00	932.
1.01	4.20	52	.01	.01	.01	24.	1.01	16.50	202	.28	.28	.00	931.
1.01	4.25	53	.01	.01	.01	24.	1.01	16.55	203	.28	.28	.00	931.
1.01	4.30	54	.01	.01	.01	24.	1.01	17.00	204	.28	.28	.00	931.

1.01	4.35	55	.01	.01	.01	26.	1.01	17.05	205	.22	.22	.00	909.
1.01	4.40	56	.01	.01	.01	25.	1.01	17.10	206	.22	.22	.00	848.
1.01	4.45	57	.01	.01	.01	25.	1.01	17.15	207	.22	.22	.00	792.
1.01	4.50	58	.01	.01	.01	26.	1.01	17.20	208	.22	.22	.00	762.
1.01	4.55	59	.01	.01	.01	26.	1.01	17.25	209	.22	.22	.00	747.
1.01	5.00	60	.01	.01	.01	26.	1.01	17.30	210	.22	.22	.00	739.
1.01	5.05	61	.01	.01	.01	27.	1.01	17.35	211	.22	.22	.00	735.
1.01	5.10	62	.01	.01	.01	27.	1.01	17.40	212	.22	.22	.00	733.
1.01	5.15	63	.01	.01	.00	27.	1.01	17.45	213	.22	.22	.00	732.
1.01	5.20	64	.01	.01	.00	28.	1.01	17.50	214	.22	.22	.00	732.
1.01	5.25	65	.01	.01	.00	28.	1.01	17.55	215	.22	.22	.00	731.
1.01	5.30	66	.01	.01	.00	28.	1.01	18.00	216	.22	.22	.00	731.
1.01	5.35	67	.01	.01	.00	28.	1.01	18.05	217	.02	.02	.00	658.
1.01	5.40	68	.01	.01	.00	29.	1.01	18.10	218	.02	.02	.00	456.
1.01	5.45	69	.01	.01	.00	29.	1.01	18.15	219	.02	.02	.00	268.
1.01	.50	70	.01	.01	.00	29.	1.01	18.20	220	.02	.02	.00	168.
1.01	5.55	71	.01	.01	.00	29.	1.01	18.25	221	.02	.02	.00	117.
1.01	6.00	72	.01	.01	.00	30.	1.01	18.30	222	.02	.02	.00	92.
1.01	.05	73	.07	.05	.03	42.	1.01	18.35	223	.02	.02	.00	79.
1.01	6.10	74	.07	.0	.02	92.	1.01	18.40	224	.02	.02	.00	72.
1.01	6.15	75	.07	.0	.02	119.	1.01	18.45	225	.02	.02	.00	69.
1.01	6.20	76	.07	.0	.02	140.	1.01	18.50	226	.02	.02	.00	67.
1.01	6.25	77	.07	.0	.02	154.	1.01	18.55	227	.02	.02	.00	66.
1.01	6.30	78	.07	.0	.01	162.	1.01	19.00	228	.02	.02	.00	66.
1.01	6.35	79	.07	.0	.01	167.	1.01	19.05	229	.02	.02	.00	66.
1.01	6.40	80	.07	.0	.01	170.	1.01	19.10	230	.02	.02	.00	66.
1.01	6.45	81	.07	.0	.01	173.	1.01	19.15	231	.02	.02	.00	66.
1.01	.50	82	.07	.06	.01	175.	1.01	19.20	232	.02	.02	.00	66.
1.01	6.55	83	.07	.06	.01	181.	1.01	19.25	233	.02	.02	.00	66.
1.01	7.0	84	.07	.06	.01	183.	1.01	19.30	234	.02	.02	.00	66.
1.01	7.0	85	.07	.06	.01	185.	1.01	19.35	235	.02	.02	.00	66.
1.01	7.10	86	.07	.06	.01	187.	1.01	19.40	236	.02	.02	.00	66.
1.01	7.15	87	.07	.06	.01	189.	1.01	19.45	237	.02	.02	.00	66.
1.01	7.20	88	.07	.06	.01	191.	1.01	19.50	238	.02	.02	.00	66.
1.01	7.25	89	.07	.06	.01	192.	1.01	19.55	239	.02	.02	.00	66.
1.01	7.30	90	.07	.06	.01	194.	1.01	20.00	240	.02	.02	.00	66.
1.01	7.35	91	.07	.06	.01	195.	1.01	20.05	241	.02	.02	.00	66.
1.01	7.40	92	.07	.06	.01	196.	1.01	20.10	242	.02	.02	.00	66.
1.01	7.45	93	.07	.06	.01	197.	1.01	20.15	243	.02	.02	.00	66.
1.01	7.50	94	.07	.06	.01	198.	1.01	20.20	244	.02	.02	.00	66.
1.01	7.55	95	.07	.06	.01	199.	1.01	20.25	245	.02	.02	.00	66.
1.01	8.00	96	.07	.06	.01	200.	1.01	20.30	246	.02	.02	.00	66.
1.01	8.05	97	.07	.06	.01	201.	1.01	20.35	247	.02	.02	.00	66.
1.01	8.10	98	.07	.06	.01	202.	1.01	20.40	248	.02	.02	.00	66.
1.01	8.15	99	.07	.06	.01	203.	1.01	20.45	249	.02	.02	.00	66.
1.01	8.20	100	.07	.06	.01	204.	1.01	20.50	250	.02	.02	.00	66.
1.01	8.25	101	.07	.06	.00	204.	1.01	20.55	251	.02	.02	.00	66.
1.01	8.30	102	.07	.06	.00	205.	1.01	21.00	252	.02	.02	.00	66.
1.01	8.35	103	.07	.06	.00	206.	1.01	21.05	253	.02	.02	.00	66.
1.01	8.40	104	.07	.06	.00	206.	1.01	21.10	254	.02	.02	.00	66.
1.01	8.45	105	.07	.06	.00	207.	1.01	21.15	255	.02	.02	.00	66.
1.01	8.50	106	.07	.06	.00	207.	1.01	21.20	256	.02	.02	.00	66.
1.01	8.55	107	.07	.06	.00	208.	1.01	21.25	257	.02	.02	.00	66.
1.01	9.00	108	.07	.06	.00	208.	1.01	21.30	258	.02	.02	.00	66.
1.01	9.05	109	.07	.06	.00	209.	1.01	21.35	259	.02	.02	.00	66.
1.01	9.10	110	.07	.06	.00	209.	1.01	21.40	260	.02	.02	.00	66.
1.01	9.15	111	.07	.06	.00	209.	1.01	21.45	261	.02	.02	.00	66.
1.01	9.20	112	.07	.06	.00	210.	1.01	21.50	262	.02	.02	.00	66.
1.01	9.25	113	.07	.06	.00	210.	1.01	21.55	263	.02	.02	.00	66.
1.01	9.30	114	.07	.06	.00	211.	1.01	22.00	264	.02	.02	.00	66.

1.01	9:35	115	.07	.06	.00	211.	1.01	22:35	265	.02	.02	.00	88.
1.01	9:40	116	.07	.06	.00	211.	1.01	22:40	266	.02	.02	.00	88.
1.01	9:45	117	.07	.06	.00	212.	1.01	22:45	267	.02	.02	.00	88.
1.01	9:50	118	.07	.06	.00	212.	1.01	22:50	268	.02	.02	.00	88.
1.01	9:55	119	.07	.06	.00	212.	1.01	22:55	269	.02	.02	.00	88.
1.01	10:00	120	.07	.06	.00	212.	1.01	23:00	270	.02	.02	.00	88.
1.01	10:05	121	.07	.06	.00	213.	1.01	23:05	271	.02	.02	.00	88.
1.01	10:10	122	.07	.06	.00	213.	1.01	23:10	272	.02	.02	.00	88.
1.01	10:15	123	.07	.06	.00	213.	1.01	23:15	273	.02	.02	.00	88.
1.01	10:20	124	.07	.06	.00	213.	1.01	23:20	274	.02	.02	.00	88.
1.01	10:25	125	.07	.06	.00	214.	1.01	23:25	275	.02	.02	.00	88.
1.01	10:30	126	.07	.06	.00	214.	1.01	23:30	276	.02	.02	.00	88.
1.01	10:35	127	.07	.06	.00	214.	1.01	23:35	277	.02	.02	.00	88.
1.01	10:40	128	.07	.06	.00	214.	1.01	23:40	278	.02	.02	.00	88.
1.01	10:45	129	.07	.06	.00	214.	1.01	23:45	279	.02	.02	.00	88.
1.01	10:50	130	.07	.06	.00	215.	1.01	23:50	280	.02	.02	.00	88.
1.01	10:55	131	.07	.06	.00	215.	1.01	23:55	281	.02	.02	.00	88.
1.01	11:00	132	.07	.06	.00	215.	1.01	24:00	282	.02	.02	.00	88.
1.01	11:05	133	.07	.06	.00	215.	1.01	24:05	283	.02	.02	.00	88.
1.01	11:10	134	.07	.06	.00	215.	1.01	24:10	284	.02	.02	.00	88.
1.01	11:15	135	.07	.06	.00	215.	1.01	24:15	285	.02	.02	.00	88.
1.01	11:20	136	.07	.06	.00	216.	1.01	24:20	286	.02	.02	.00	87.
1.01	11:25	137	.07	.06	.00	216.	1.01	24:25	287	.02	.02	.00	87.
1.01	11:30	138	.07	.06	.00	216.	1.02	0:00	288	.02	.02	.00	87.
1.01	11:35	139	.07	.06	.00	216.	1.02	.05	289	0.00	0.00	0.00	59.
1.01	11:40	140	.07	.06	.00	216.	1.02	.10	290	0.00	0.00	0.00	39.
1.01	11:45	141	.07	.07	.00	216.	1.02	.15	291	0.00	0.00	0.00	20.
1.01	11:50	142	.07	.07	.00	216.	1.02	.20	292	0.00	0.00	0.00	10.
1.01	11:55	143	.07	.07	.00	216.	1.02	.25	293	0.00	0.00	0.00	5.
1.01	12:00	144	.07	.07	.00	217.	1.02	.30	294	0.00	0.00	0.00	3.
1.01	12:05	145	.20	.20	.00	268.	1.02	.35	295	0.00	0.00	0.00	1.
1.01	12:10	146	.20	.20	.00	397.	1.02	.40	296	0.00	0.00	0.00	1.
1.01	12:15	147	.20	.20	.00	519.	1.02	.45	297	0.00	0.00	0.00	0.
1.01	12:20	148	.20	.20	.00	586.	1.02	.50	298	0.00	0.00	0.00	0.
1.01	12:25	149	.20	.20	.00	619.	1.02	.55	299	0.00	0.00	0.00	0.
1.01	12:30	150	.20	.20	.00	637.	1.02	1.00	300	0.00	0.00	0.00	0.
									SUM	31.20	30.04	1.16	99961.
										(792.)	(763.)	(29.)	(2830.58)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4941.	1005.	347.	333.	99992.
CMS	140.	28.	10.	9.	2831.
INCHES		.35	30.04	30.04	30.04
MM		601.69	763.11	763.11	763.11
AC-FT		543.	689.	689.	689.
THOUS CU M		670.	849.	849.	849.

HYDROGRAPH AT STA 30017 FOR PLAN 1, RTIO 1

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.	
0.	0.	0.	0.	0.	0.	0.	1.	2.	3.	
4.	5.	6.	7.	8.	9.	10.	10.	11.	12.	
13.	13.	14.	15.	15.	16.	17.	17.	18.	18.	
19.	19.	20.	20.	21.	21.	22.	22.	23.	23.	
23.	24.	24.	24.	25.	25.	26.	26.	26.	28.	
27.	27.	27.	28.	28.	28.	28.	29.	29.	29.	
29.	30.	43.	82.	119.	140.	153.	162.	167.	172.	
175.	178.	181.	183.	185.	187.	189.	191.	192.	194.	

196.	196.	197.	198.	199.	200.	201.	202.	203.	204.
204.	205.	206.	206.	207.	207.	208.	208.	209.	209.
210.	210.	210.	211.	211.	211.	212.	212.	212.	212.
213.	213.	213.	213.	214.	214.	214.	214.	214.	215.
215.	215.	215.	215.	215.	216.	216.	216.	216.	216.
214.	214.	214.	217.	260.	397.	510.	586.	619.	637.
643.	651.	657.	665.	656.	656.	671.	712.	749.	770.
785.	786.	788.	793.	791.	792.	792.	793.	815.	828.
831.	962.	977.	985.	980.	991.	993.	993.	994.	994.
1451.	1896.	1974.	1152.	1431.	2057.	3534.	4041.	4688.	3596.
2714.	2050.	1608.	1310.	1124.	1028.	976.	949.	938.	934.
932.	931.	931.	931.	909.	844.	792.	762.	747.	739.
735.	733.	732.	742.	731.	731.	658.	456.	26 .	168.
117.	75.	75.	72.	69.	67.	66.	66.	66.	66.
66.	66.	66.	66.	66.	66.	66.	66.	66.	66.
66.	66.	66.	66.	66.	66.	66.	66.	66.	66.
66.	66.	66.	66.	66.	66.	66.	66.	66.	66.
66.	66.	66.	66.	66.	66.	66.	66.	66.	66.
66.	66.	66.	66.	66.	66.	66.	66.	66.	66.
66.	66.	66.	66.	66.	66.	67.	67.	59.	39.
20.	10.	5.	3.	1.	1.	0.	0.	0.	0.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	4341.	1956.	347.	333.	99992.
CMS	123.	55.	10.	9.	2831.
INCHES		21.69	32.04	30.04	30.04
MM		551.09	767.11	743.11	763.11
AC-FT		544.	689.	660.	609.
THOUS CU M		670.	849.	814.	749.

HYDROGRAPH AT STA 30017 FOR PLAN 1, RTIO 2

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	1.	1.	2.
2.	2.	3.	4.	4.	4.	5.	5.	6.	6.
6.	7.	7.	7.	8.	8.	9.	9.	9.	9.
9.	10.	10.	10.	10.	11.	11.	11.	11.	11.
12.	12.	12.	12.	12.	13.	13.	13.	13.	13.
13.	14.	14.	14.	14.	14.	14.	14.	14.	15.
15.	15.	22.	41.	59.	70.	77.	81.	84.	86.
88.	89.	91.	92.	93.	94.	95.	95.	96.	97.
97.	98.	99.	99.	100.	100.	101.	101.	101.	102.
102.	102.	103.	103.	103.	104.	104.	104.	104.	105.
105.	105.	105.	105.	105.	106.	106.	106.	106.	106.
106.	106.	107.	107.	107.	107.	107.	107.	107.	107.
107.	107.	108.	108.	108.	108.	108.	108.	108.	108.
108.	108.	108.	108.	132.	196.	260.	293.	310.	316.
313.	325.	327.	325.	326.	326.	336.	356.	375.	388.
390.	393.	394.	396.	396.	396.	396.	396.	407.	438.
466.	481.	483.	493.	495.	496.	496.	497.	497.	497.
476.	459.	487.	576.	715.	1029.	1769.	2471.	2340.	1798.
1352.	1025.	804.	655.	562.	514.	488.	474.	469.	467.
466.	465.	465.	469.	484.	424.	396.	381.	373.	369.
368.	367.	366.	366.	366.	366.	329.	228.	130.	89.
59.	46.	39.	36.	35.	34.	33.	33.	33.	33.
33.	33.	33.	33.	33.	33.	33.	33.	33.	33.
33.	33.	33.	33.	33.	33.	33.	33.	33.	33.
33.	33.	33.	33.	33.	33.	33.	33.	33.	33.
33.	33.	33.	33.	33.	33.	33.	33.	33.	33.

33.	33.	33.	33.	33.	33.	33.	33.	33.	33.	
33.	33.	33.	33.	33.	33.	33.	33.	33.	19.	
19.	9.	5.	1.	1.	0.	0.	0.	0.	0.	

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2471.	548.	174.	167.	49996.
CMS	70.	16.	5.	5.	1416.
INCHES		11.84	15.02	15.02	15.02
MM		300.84	381.56	381.56	381.56
AC-FT		271.	344.	344.	344.
THOUS CU M		334.	425.	425.	425.

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HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH COURTNEY DAM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
30017	1	0	0	2	0	1	0	0

ROUTING DATA

LSTR
0

LOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	IPRAT
1	0	0	0.000	0.000	0.000	-946.	-1

STAGE	846.00	847.00	848.00	849.30	850.70	851.15	852.00	853.50	853.39	854.64
FLOW	0.00	24.00	47.00	80.00	285.00	733.00	1140.00	1921.00	4457.00	9462.00

CAPACITY=	0.	144.	198.	255.	490.	1750.

ELEVATION=	822.	846.	848.	852.	860.	880.

CREL	SPWID	COOD	EXPD	ELEVL	COOL	CAREA	EXPL
846.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
852.0	0.0	0.0	0.

STATION 30017, PLAN 1, RATIO 1

END-OF-PERIOD HYDROGRAPH ORDINATES

OUTFLOW

0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	1.	1.
1.	1.	1.	1.	1.	1.	1.	2.	2.	2.
2.	2.	2.	2.	3.	3.	3.	3.	3.	3.
4.	4.	4.	4.	4.	5.	5.	5.	5.	5.
5.	6.	6.	6.	6.	6.	7.	7.	7.	7.
7.	7.	8.	8.	9.	10.	11.	12.	14.	15.
16.	18.	19.	21.	22.	23.	25.	28.	30.	33.

SUMMARY OF PMF AND ONE-HALF PMF FLOOD ROUTING

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO APPLIED TO FLOWS		
				RATIO 1 1.00	RATIO 2 .50	
HYDROGRAPH AT	30017	.43	1	4941.	2471.	
		(1.11)		(139.93)	(69.96)	
ROUTED TO	30017	.43	1	3967.	1904.	
		(1.11)		(112.34)	(79.76)	

SUMMARY OF DAM SAFETY ANALYSIS

PLAN: 1 xxxxxxxxxxxxxxx

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	844.00	846.00	852.00
STORAGE	144.	144.	255.
OUTFLOW	0.	0.	1145.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE ACRE-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	853.03	1.03	291.	3567.	1.00	15.83	0.00
.50	852.17	.17	260.	1404.	.33	15.92	0.00

PERCENT OF PMF FLOOD ROUTING
EQUAL TO SPILLWAY CAPACITY

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************

RUN  DATE= 79/06/19.
     TIME= 18.30.36.
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DAM SAFETY INSPECTION - MISSOURI
DR COURTNEY DAM (30017)
PERCENT OF PMF DETERMINATION AND ROUTING

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
330	0	5	0	0	0	0	0	4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1

RTIOS= .45 .46 .47 .48 .49 .50 .51 .52 .53

SUB-AREA RUNOFF COMPUTATION

INPUT INDEX PRECIPITATION AND RATIOS, INPUT SCS UNIT HYDROGRAPH PARAMETERS

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
30017	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.43	0.00	.43	1.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.00	100.00	130.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-91.00	0.00	0.00

CURVE NO = -91.00 (METNESS = -1.00 EFFECT CN = 91.00)

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .16

RECESSION DATA
STRTQ= 0.00 QRCSN= 0.00 RTIOR= 1.00

END-OF-PERIOD FLOW

HO.	DA	HR.	MN	PERIOD	RAIN	EXCS	LOSS	COMP Q		HO.	DA	HR.	MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM 31.20 30.04 1.18 99801.
(792.1)(785.1)(29.9)(2830.58)

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* HYDROGRAPH ROUTING

ROUTE HYDROGRAPH THROUGH DR COURTNEY DAM

ISTAO	ICOMP	IECON	ITAPE	JPLT	JRT	INAME	ISTAGE	IAUTO
30017	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.06	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-846.	-1

STAGE	846.00	847.00	848.00	848.30	849.75	851.15	852.00	852.50	853.39	854.64
FLOW	0.00	24.00	67.00	80.00	298.00	733.00	1148.00	1921.00	4457.00	9462.00
CAPACITY=	0.	144.	188.	255.	490.	1750.				
ELEVATION=	822.	846.	848.	852.	860.	880.				

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
846.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
852.0	0.0	0.0	0.

PEAK OUTFLOW IS 1142. AT TIME 15.92 HOURS

PEAK OUTFLOW IS 1197. AT TIME 15.92 HOURS

PEAK OUTFLOW IS 1256. AT TIME 15.92 HOURS

PEAK OUTFLOW IS 1305. AT TIME 15.92 HOURS

PEAK OUTFLOW IS 1355. AT TIME 15.92 HOURS

PEAK OUTFLOW IS 1404. AT TIME 15.92 HOURS

PEAK OUTFLOW IS 1453. AT TIME 15.92 HOURS

PEAK OUTFLOW IS 1502. AT TIME 15.92 HOURS

PEAK OUTFLOW IS 1548. AT TIME 15.92 HOURS

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1 .45	RATIO 2 .46	RATIO 3 .47	RATIO 4 .48	RATIO 5 .49	RATIO 6 .50	RATIO 7 .51	RATIO 8 .52	RATIO 9 .53
HYDROGRAPH AT	30017	.43 (1.11)	1	2224. (62.97)	2273. (64.37)	2323. (65.77)	2372. (67.17)	2421. (68.56)	2471. (69.96)	2820. (71.36)	2578. (72.76)	2619. (74.16)
ROUTED TO	30017	.43 (1.11)	1	1142. (32.34)	1197. (33.91)	1256. (35.55)	1315. (36.97)	1355. (38.37)	1404. (39.76)	1453. (41.15)	1502. (42.54)	1548. (43.83)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	846.00	846.00	852.00
STORAGE	144.	144.	255.
OUTFLOW	0.	0.	1148.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.45	851.99	0.00	255.	1142.	0.00	15.92	0.00
.46	852.03	.03	256.	1197.	.17	15.92	0.00
.47	852.07	.07	257.	1256.	.25	15.92	0.00
.48	852.10	.10	258.	1305.	.25	15.92	0.00
.49	852.13	.13	259.	1355.	.33	15.92	0.00
.50	852.17	.17	260.	1404.	.33	15.92	0.00
.51	852.20	.20	261.	1453.	.33	15.92	0.00
.52	852.23	.23	262.	1502.	.33	15.92	0.00
.53	852.26	.26	262.	1548.	.42	15.92	0.00


DATE
ILME